

# WHICH RURAL HOSPITALS MERGE AND WHAT HAPPENS TO THEM AFTERWARD?

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## ABSTRACT

John Duncan Williams, Jr.: Which Rural Hospitals Merge and What Happens to Them  
Afterward?

(Under the direction of Paula Song)

The goals of this dissertation were to determine 1) when and how many rural hospitals merged, 2) pre-merger hospital- and market-level antecedents of rural hospitals, and 3) whether post-merger inpatient charges, outpatient charges and capital expenditures changed at target rural hospitals. Multiple secondary data sources were combined to form a panel for years 2004-2016. A hospital's merger status was derived from proprietary data found in the "The Health Care Services Acquisition Report" by Irving Levin Associates for 2005-2016.

In study one, a discrete-time hazard analysis with generalized estimating equations was used to determine whether hospital- and market-level factors were associated with rural hospitals merging between 2005 and 2016. Rural hospitals with higher odds of merging were less profitable, for-profit, larger and were less likely to be able to cover current debt. Additional factors associated with higher odds of merging were reporting older plant age, not providing obstetrics, being closer to the nearest large hospital, and not being in the West region.

In study two, a difference-in-differences approach was used to determine whether inpatient and outpatient charges changed at rural hospitals after a merger. The adjusted difference-in-differences estimates revealed that, compared to similar non-merged rural hospitals over the same period, merging was associated with a statistically significant 3.04% decrease in inpatient charges. For outpatient charges, merging was associated with a 1.07% increase in

outpatient charges ( $p=0.082$ ). While the outpatient finding was not statistically significant at  $p<0.05$ , it showed a statistical trend and may have been of clinical importance.

In study three, a difference-in-differences approach was used to determine whether total capital expenditures changed at rural hospitals after a merger. The adjusted difference-in-differences estimates revealed that, compared to similar non-merged rural hospitals over the same period, merging was associated with a statistically significant 26.4% increase in total capital expenditures.

Taken together, these studies provided insight into some factors associated with rural hospital mergers for both pre- and post-merger time periods and could assist policy- and decision-makers responding to rural hospital merger activity and effects.

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## LIST OF ABBREVIATIONS

A&G	Administrative and General
ACA	Patient Protection and Affordable Care Act
ACO	Accountable Care Organization
AHRQ	Agency for Healthcare Research and Quality
AHRF	Area Health Resource File
ARM	Annual Research Meeting
CABGs	Coronary Artery Bypass Grafts
CAH	Critical Access Hospital
CCA	Complete Case Analysis
CCR	Cost to Charge Ratio
CMS	The Center for Medicare & Medicaid Services
DOJ	Department of Justice
DSCR	Debt Service Coverage Ratio
EBIT	Earnings Before Interest and Taxes
ED	Emergency Department
EHR	Electronic Health Record
FFS	Fee for Service
FORHP	Federal Office of Rural Health Policy
FTC	Federal Trade Commission
FTE	Full-Time Equivalent
GEE	Generalized Estimating Equations
HCRIS	Healthcare Cost Reporting Information System
HITECH Act	The Health Information Technology for Economic and Clinical Health Act
IPTW	Inverse Probability of Treatment Weights

IRS	Internal Revenue Service
IT	Information Technology
MACRA	Medicare Access and CHIP Reauthorization Act
MSA	Market Service Area
OB-GYN	Obstetrics and Gynecology
PPS	prospective payment system
PTCAs	Percutaneous Transluminal Coronary Angioplasties
US	United States
VBP	Value-Based Payments

## CHAPTER 1. INTRODUCTION

A wave of hospital mergers is reshaping the health care landscape in both rural and urban communities across the United States.<sup>1</sup> To thrive or survive amidst decreasing inflation-adjusted reimbursement rates<sup>2</sup> and environmental pressures to consolidate resources,<sup>3,4</sup> hospitals must become more efficient<sup>5</sup> while simultaneously improving health outcomes.<sup>4</sup> Merging with another hospital is one mechanism for managing these pressures. A 2017 industry survey of hospital executives conducted by Deloitte and HFMA showed that executives from *acquiring* hospitals most commonly reported merging to increase market share (40%) and deliver care more efficiently (29%).<sup>5</sup> The same survey reported that executives of hospitals *targeted* in a merger most commonly merged to improve access to capital (31%), deliver care more efficiently (29%), and increase market share (14%).<sup>5</sup> Since 2010, hospital mergers have increased in frequency, cost, and number of entities involved.<sup>6</sup> Between 2011 and 2016, an average of 95 hospital merger transactions occurred annually, compared to 61 per year between 2008 and 2010.<sup>6</sup> It is unclear whether rural hospitals followed a similar trend. As the number of hospital mergers continues to rise,<sup>7,8</sup> it is important to understand the characteristics of rural hospitals that merge and what happens to them afterward.

Five known academic studies identified characteristics associated with whether a hospital merged.<sup>8-12</sup> Of those studies, only two evaluated characteristics associated with *rural* hospitals that merged.<sup>8,12</sup> The growing U.S. hospital merger literature suggests that hospitals with certain characteristics are more likely to merge (e.g., those closer to other hospitals)<sup>9,10</sup> and that many outcomes can be affected by a merger (e.g., reducing services provided,<sup>13,14,15</sup> staffing levels,<sup>13</sup>

and costs<sup>16</sup> but increasing prices<sup>17-19</sup> and capital expenditures).<sup>5</sup> However, for target rural hospitals, the literature is mostly either nonexistent or inconclusive. Since rural hospitals differ from non-rural hospitals in fundamental ways (e.g., serve a more vulnerable population with worse health outcomes, are often the only acute care providers in the communities they serve, provide smaller volumes of care and less specialty services, and are more likely to be financially distressed),<sup>12,20-25</sup> it is likely that mergers impact rural hospitals differently. Noles et al. identified some characteristics associated with whether a rural hospital merges and whether outcomes change at merged rural hospitals; but, their study did not consider or was inconclusive on important factors related to distance, service lines, and financial measures.<sup>12</sup>

This research is important for rural hospitals, which serve older, sicker, and poorer populations<sup>20,21,26,27</sup> than non-rural populations. These hospitals have lower patient volumes and face a number of workforce recruitment and patient transfer barriers.<sup>20,21,26,27</sup> Compared to non-rural counterparts, rural hospitals are slower to adopt capital-intensive renovations and technology like EHRs required for enhanced CMS reimbursement.<sup>28,29</sup> Together, these factors have left many rural hospitals facing significant financial challenges<sup>24</sup> and have put some at risk for closure.<sup>30</sup> Merging may be one of the best options for these rural hospitals to remain in business,<sup>31</sup> stabilize financial performance, and invest in facilities and technology to improve patient care.<sup>12,32</sup>

Rural hospitals might be attractive targets to larger acquiring hospitals or hospital systems. Rural hospitals are commonly the only acute care providers in their markets<sup>20,21</sup> and typically have fewer competitors. Merging with a rural hospital could allow an acquirer to increase market power by becoming the largest health care provider in the rural community.

After a merger, acquirers may coordinate care across sites by steering patients from the target to



receive care at the acquirer<sup>13,33</sup> and reduce costs by consolidating staff and the number of sites providing the same care.<sup>12,34</sup>

Merging with a large acquirer may have both positive and negative impacts on rural hospitals and the communities they serve. Rural hospitals generally have lower acute inpatient utilization rates than urban hospitals.<sup>35</sup> For certain outcomes, higher volumes of procedures performed have been associated with better quality.<sup>19,36</sup> Therefore, consolidating inpatient services to a site outside the rural community (e.g., the acquiring hospital) may improve quality of care for those outcomes by increasing the number of procedures performed at that site.<sup>19,36</sup> However, consolidation could also reduce access for patients unable to travel to that site.<sup>37-39</sup> For time-sensitive services like heart attacks, seizures, and stroke, increased travel time may negatively impact quality in those communities. Mergers are also likely to affect outpatient service delivery. Acquirers could expand outpatient services at the rural hospital to take advantage of the rural hospital's market, which may have less competition. Increasing outpatient services could generate a higher number of downstream referrals for more complex and potentially more profitable services offered at the acquirer.<sup>40,41</sup> To increase outpatient services, acquirers would likely need to invest capital into the rural hospital for renovations, expansion, and new technology.

The objectives of this research are to determine 1) when and how many rural hospitals merged, 2) pre-merger hospital- and market-level characteristics of target rural hospitals, and 3) whether post-merger inpatient charges, outpatient charges, and capital expenditures change at target rural hospitals. The first study (Chapter 2) quantifies rural hospital mergers and identifies the types of rural hospitals that are more likely to merge. The second and third studies (Chapters 3 and 4, respectively) identify post-merger operational changes at merged rural hospitals that

may benefit rural stakeholders considering the potential impact of a merger. It is important to examine these factors in the same set of hospitals and over the same time period because they may have a reciprocal relationship. Taken together, these studies provide insight into some factors associated with rural hospital mergers for both pre- and post-merger time periods that can assist policy- and decision-makers responding to rural hospital merger activity and effects.

The sections of this dissertation are organized as follows. Chapters 2-4 are manuscripts for studies 1-3, respectively. Chapter 5 summarizes the findings of this dissertation and provides implications for practice, policy, and research.

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## **CHAPTER 2. STUDY 1 PAPER: FINANCIAL AND MARKET CHARACTERISTICS ASSOCIATED WITH RURAL HOSPITALS THAT MERGED BETWEEN 2005 AND 2016**

### **Overview**

#### **Objective**

To determine whether key hospital-level financial and market characteristics are associated with whether rural hospitals merge.

#### **Data Sources**

Hospital merger status derived from proprietary Irving Levin Associates data for 2005 through 2016 and hospital-level characteristics from HCRIS, CMS Impact File Hospital Inpatient Prospective Payment System, Hospital MSA file, AHRF, and U.S. Census data for 2004 through 2016.

#### **Study Design**

A discrete-time hazard analysis using generalized estimating equations was used to determine whether factors were associated with merging between 2005 and 2016. Factors included measures of profitability, operational efficiency, capital structure, utilization, and market competitiveness.

#### **Principal Findings**

Between 2005 and 2016, eleven percent ( $n=326$ ) of rural hospitals were involved in at least one merger. Rural hospital mergers have increased in recent years, with more than two-thirds ( $n=261$ ) occurring after 2011. The types of rural hospitals that merged during the sample period differed from non-merged rural hospitals. Rural hospitals with higher odds of merging

were less profitable, for-profit, larger and were less likely to be able to cover current debt. Additional factors associated with higher odds of merging were reporting older plant age, not providing obstetrics, being closer to the nearest large hospital, and not being in the West region.

## **Conclusions**

By quantifying the hazard of characteristics associated with whether rural hospitals merged between 2005 and 2016, these findings suggest it is possible to determine leading indicators of rural mergers. This work may serve as a foundation for future research to determine the impact of mergers on rural hospitals.

## **Introduction**

Across the nation, hospitals are merging to cut costs and streamline resources<sup>1</sup> in the face of growing financial pressures and extensive policy changes.<sup>2-6</sup> Since 2010, hospital mergers have increased in frequency, cost, and number of entities involved.<sup>7</sup> It is unclear whether rural hospital mergers are occurring at the same rate as non-rural mergers. Rural hospitals face unique challenges compared to their non-rural counterparts. On average, rural hospitals provide fewer services, have lower patient volumes and a poorer payer mix, and are less profitable than non-rural hospitals.<sup>8-12</sup> Rural hospitals are also more sensitive to reimbursement changes and encounter obstacles in regard to provider recruitment and patient transfers.<sup>8-11</sup> These key differences suggest rural hospital mergers could be different than other hospital mergers and should therefore be examined separately. It is important to understand how many rural hospitals are merging and if certain types of rural hospitals are more likely to merge than others. Then, further research can determine what impacts mergers have on rural communities.

Previous research found hospitals that merge were more likely to be closer in distance,<sup>13,14</sup> not-for-profit, and of similar size to the acquirer.<sup>14</sup> However, these studies offer limited inference for recent rural hospital mergers for two key reasons. One, none of those

studies separately evaluated rural hospitals. And two, none of those studies assessed hospital mergers after 2000, during which time hospital reimbursement underwent substantial shifts from FFS to outcomes-based, which may have impacted merger motives. Little is known about the types of *rural* hospitals that merge. Noles et al. (2015) found lower total margin, a smaller proportion of equity financing, and a smaller proportion of Medicare outpatient revenue to total outpatient revenue were all associated with a higher likelihood for *rural* hospitals to merge.<sup>15</sup> However, the Noles et al. study did not consider or was inconclusive on whether several important hospital-level operational and market factors were associated with rural hospital mergers.<sup>15</sup>

Following a merger,<sup>1</sup> target hospitals have been shown to decrease services provided,<sup>16-18</sup> staffing levels,<sup>17</sup> and costs,<sup>19</sup> but increase capital expenditures<sup>20</sup> and prices.<sup>21-24</sup> Post-merger effects such as these could have significant impacts on rural communities. Rural communities are vulnerable to changes because their residents are, on average, older, poorer, and sicker<sup>8,9</sup> than non-rural community members. Any of the aforementioned post-merger effects could jeopardize access to care for vulnerable rural residents<sup>25,26</sup> as well as impact the economic state of communities served by these hospitals, which are often the largest employers in rural areas.<sup>27</sup>

The objective of this study was to determine whether key hospital and market characteristics were associated with whether rural hospitals merged between 2005 and 2016. Policy-makers cannot take informed action on existing and future policies regarding rural merger impacts without first knowing what types of rural hospitals are more likely to merge. Understanding the characteristics of rural hospitals that merge prepares rural hospital leaders and policy-makers to anticipate future mergers and prepare for potential changes within the rural health care landscape.



## Conceptual Framework

This study builds upon the conceptual framework of mergers and acquisitions developed by Haleblan et al. (2009)<sup>28</sup> that posits an array of antecedents (e.g., value creation, managerial self-interest, environmental factors, and firm characteristics) influence merger behavior and that moderators (e.g., deal characteristics, managerial effects, firm characteristics, and environmental factors) affect outcomes related to mergers. This framework has been adapted for rural hospitals targeted in a merger and is presented in Figure 2.1.

For rural hospitals targeted in a merger, we hypothesize that the most common merger motives are related to Haleblan et. al.'s value creation antecedent. Specifically, we hypothesize that rural targets merge to improve financial performance and, at times, survive, and that acquirers merge to increase market power.<sup>17,29-31</sup> For rural hospitals reporting weak finances, a merger may improve the ability to meet the demands of CMS outcomes-based reimbursement policies and EHR adoption requirements that require expensive investments in facilities, equipment, and EHRs<sup>32</sup> (unobserved environmental factor antecedents in the Haleblan et al. framework). Acquirers seeking greater market power may be particularly attracted to rural merger targets because rural hospitals are 1) often the only acute care providers in the communities they serve<sup>8,9</sup> and 2) less likely than non-rural hospitals to provide specialty services offered at larger hospitals.<sup>33</sup> Acquirers may leverage these factors to steer patients who require complex and potentially more profitable care away from targets to the acquirers.<sup>17,30</sup>

Because we hypothesize that the finances and potential market power of rural target hospitals determine whether rural hospitals merge, we test a variety of hospital-level characteristics identified in Table 2.1. Profitability, operational efficiency, capital structure, utilization, and other hospital characteristics depict value creation at the target rural hospital. We hypothesize that the odds of merging are higher for rural hospitals that report worse profitability,

operational efficiency, capital structure, and utilization because these hospitals have less leverage by which to negotiate better merger terms. For these rural hospitals, an acquirer may view the merger as opportunistic for efficiency improvements and to increase market power. By evaluating market competitiveness and other market characteristics, hospital administrators can evaluate the potential of a merger to create value through increased market power. We hypothesize that the odds of merging are higher for rural hospitals in larger, more competitive markets. In keeping with Haleblian et. al.'s framework, other managerial, environmental, and firm antecedents are likely associated with merger behavior but are unobserved in this research.

## **Methods**

### **Data Sources**

We combined multiple secondary data sources to form a panel for years 2004-2016. For those years, hospital-level characteristics were combined from HCRIS “cost report” data, the CMS Impact File Hospital Inpatient Prospective Payment System, the Hospital MSA file, the AHRF, and U.S. Census data. Data from hospital-reported cost report fiscal years (HFYs) was combined with a hospital’s merger status. A hospital’s merger status was derived from proprietary data found in the “The Health Care Services Acquisition Report” by Irving Levin Associates for 2005–2016.

### **Study Sample**

To define the sample, we combined rural hospital merger status with hospital Medicare Cost Reports from 2004-2016. The Levin data report a merger “announcement date,” which may have: 1) included hospitals that did not merge during the sample period and 2) represented a date other than that on which ownership transferred. To verify when and whether an “announced” merger occurred, we created an “effective” date through searching publicly-available documents online (e.g., for-profit IRS Form 10-Ks, not-for-profit IRS Form 990s, and annual reports from

hospital websites) and, when necessary, calling and emailing leaders of rural hospitals. Because we analyzed data by discrete years, not specific dates within a year, it was necessary to align effective merger dates with the correct HFY. Doing so was essential to compare hospital data from the correct time period because the HFY differed from the calendar year of the effective date approximately two-thirds of the time.<sup>34</sup> We excluded partial-year data reporting for less than 360 days<sup>35</sup> (n=2,186).

From the Levin data, we identified 395 rural hospitals that were announced to have merged. Rurality was defined according to the Federal Office of Rural Health Policy definition: short-term, nonfederal general facilities 1) located outside Metropolitan Core-Based Statistical Areas (CBSAs) or 2) within Metropolitan areas and having Rural-Urban Commuting Area (RUCA) codes of four or greater or 3) with CAH status.<sup>36</sup> Of the 395 rural hospitals, we excluded 16 announced deals that did not close, closed in 2017, or may still be pending, thus leaving 379 mergers involving rural hospitals. Because 39 rural hospitals merged more than once during the sample period, there were 326 unique rural hospitals that merged between 2005 and 2016.

Of the 326 unique rural hospitals that merged, we excluded 44 that did not report full-year cost report data in the year of analysis (e.g., the year prior to merger), resulting in 282 unique merged rural hospitals. The final sample consisted of 25,065 hospital-years, 282 of which were associated with a merger and 24,783 of which were not.

## **Study Variables**

### *Dependent Variable*

The dependent variable was a binary measure for whether a hospital merged during a year.

## *Independent Variables*

As described in the “Conceptual Framework” section, we hypothesized that the most likely rural hospitals to merge were 1) less profitable and 2) in more favorable markets. We tested these hypotheses with hospital-level characteristics that have been found to impact hospital performance<sup>37-42</sup> and may have affected the odds that a hospital will merge (outlined in Table 2.1).<sup>13-15,20,43</sup>

### Profitability

We measured profitability with total margin. Total margin is widely encompassing and is often used to assess the financial performance of hospitals involved in mergers and system consolidations.<sup>1,29,44-46</sup>

### Operational Efficiency

We measured hospital operational efficiency with full time equivalents (FTEs) per bed and the Medicare outpatient cost to charge ratio (CCR). FTEs per bed<sup>47</sup> controlled for potential differences in patient volumes and/or staff productivity. CCR controlled for potential differences in billing and/or cost inefficiencies.<sup>47</sup>

### Capital Structure

We measured capital structure with a measure of a hospital’s ability to cover debt payments. To control for a hospital’s ability to pay existing debt, we created a measure called “ability to cover debt payments” using debt service coverage ratios (DSCRs).<sup>47</sup> We categorized non-missing DSCRs  $\geq 1$  as able to cover current debt and non-missing DSCRs  $< 1$  as unable to cover current debt.

### Utilization

We measured utilization with Medicare outpatient payer mix<sup>13,48</sup> and whether a hospital provided obstetric services. The proportion of Medicare outpatient payer mix controlled for

government-reimbursed payer mix. Outpatient revenue accounted for the largest proportion (nearly two-thirds) of all revenue generated by rural hospitals in the sample.<sup>34</sup> Whether a rural hospital provided obstetric services controlled for service mix differences. Fewer rural hospitals provide obstetrics, with over 7% of all rural hospitals closing their obstetric units between 2004 and 2014.<sup>49-51</sup> Providing obstetrics may indicate broader associations with other services provided by rural hospitals.

### Other Hospital Characteristics

We measured other hospital characteristics we hypothesized determine whether rural hospitals merge. Those factors included ownership status, average plant age, hospital size, and whether a hospital is a CAH. Hospital ownership – categorized as private for-profit, private not-for-profit, and government-owned – controlled for differing financial objectives.<sup>52-55</sup> Average plant age, measured as quartiles for all merged and non-merged rural hospitals in each analytical year, controlled for the age of fixed assets.<sup>47</sup> Hospital size, measured by Net Patient Revenue (NPR) (quartiles), controlled for potential scale opportunities. Compared to measuring hospital size by the number of beds, NPR has been theorized to be a more sensitive measure for rural hospitals.<sup>41</sup>

For this research, CAHs are compared to rural PPS hospitals – an approach informed by prior hospital finance literature<sup>56</sup> that served to control for Medicare cost-based reimbursement to CAHs.<sup>57</sup> CAHs receive cost-based reimbursement to reduce financial vulnerability and improve access to care in rural communities.<sup>58</sup> CAHs generally have smaller, less competitive markets than other rural PPS hospitals.<sup>59,60</sup>

### Market Competitiveness

We measured market competitiveness with distance to the nearest large (e.g., >100 bed) hospital and the proportion of total market share captured.

Hospital market areas were created using Medicare discharge counts by ZIP code from the CMS Hospital Service Area File. A ZIP code was included in the market if, when sorted in descending number of that hospital's Medicare discharges, it was among the ZIPs that comprised the first seventy-five percent of that hospital's Medicare discharges<sup>61</sup> or if it contributed at least three percent of that hospital's Medicare admissions for the year. Except for hospitals in Alaska and Hawaii, ZIP codes more than 150 miles from the hospital were disqualified from being in its market. The market areas were not specified to be mutually exclusive, exhaustive, or contiguous. Low-population or low Medicare population ZIP code areas in otherwise dense areas were more likely to be excluded from a market based on this definition. Averages for market variables were calculated as the population-weighted average of the ZIP code data.

Distance to the nearest large (e.g., >100 bed) hospital controlled for proximity to other hospitals. Various measures of proximity have been associated with an acquirer's ability to increase market power.<sup>23,29,62</sup> While the nearest large hospital was not always the acquirer, this research was limited by not knowing the acquirer. Therefore, distance was measured to the nearest large hospital. We determined the distance from each hospital to the next closest hospital using straight-line distance between coordinates geocoded from CMS addresses. We took the natural log of distance to address suspected variation in the rate of the relationship of distance with the odds of merging. Market share captured, measured as the proportion of inpatient discharges captured within a hospital's market, controlled for market competition.

#### Other Market Characteristics

We measured other market characteristics with total population,<sup>19</sup> unemployment rate,<sup>63,64</sup> and region.<sup>44</sup> Population controlled for market size.<sup>57</sup> Unemployment rate controlled for local economic conditions<sup>57</sup> and the average community member's likelihood to seek and ability

to pay for health care services.<sup>10,25</sup> Region controlled for potential unobserved geographic differences.

### **Study Design**

Formally, we specified generalized estimating equations with a logit link; an exchangeable error term for repeated observations recognized that time-invariant unobserved hospital-specific characteristics affected merger status. Informed by Dranove and Lindrooth's (2003) approach,<sup>13</sup> only hospital characteristics from the previous year were used to model merger activity. For example, a hospital's 2004 profitability was used to model its 2005 merger status.

Because we were interested in modeling merger activity in a year, we leveraged the longitudinal nature of the data and specified a discrete-time hazard analysis. As with any merger analysis, our sample was limited by left and right censoring (e.g., we did not know which hospitals merged before the sample period began in 2005 or after the sample period ended in 2016). However, we leveraged the new knowledge of which hospitals merged and did not merge during the sample period to create a comparison group. We compared hospitals that merged during the sample period to a control group comprised of 1) rural hospitals that did not merge during the sample period and 2) rural hospitals that ultimately merged during the sample period – but merged more than one year in the future. We further explain the treatment and control groups with an example in the Appendix 1.

We accounted for unobserved correlation of year-specific effects with model variables and merger status (e.g., implementation of various CMS reimbursement policies) by including year fixed effects. We cleaned data for completeness using complete case analysis (CCA) and addressed extreme values by Winsorizing<sup>65</sup> (censoring) those values at the one percent tails of each variable's distribution.<sup>19</sup> Standard errors were calculated with a bootstrap (500 repetitions).

Descriptive statistics were weighted by two factors: 1) the annual proportion of merged hospitals relative to all mergers and 2) days in period (DIP). For example, 7 of the 282 merged hospital-years occurred in 2005. Therefore, descriptive statistics for merged and non-merged hospital-years for 2005 were weighted as  $7/282^{\text{nds}}$  of the overall means/medians. Statistics were then weighted at the hospital year-level for DIPs. Differences between groups were tested using Pearson's chi-square (categorical variables) and Wilcoxon rank test of medians (continuous variables) using 0.05 as the probability of Type 1 error.

## Results

### Geographic Distribution of Rural Hospitals that Merged between 2005 and 2016

The geographic location of all 326 unique rural hospitals that merged from 2005 through 2016 is displayed in Figure 2.2. Over half of all merged hospitals ( $n=173$ ) were in 11 states (OK, TX, WI, NC, TN, PA, VA, AL, MI, GA, and IL). Mergers occurred the most frequently in Oklahoma ( $n=22$ ), Texas ( $n=22$ ), and Wisconsin ( $n=19$ ). Of states with at least 25 total rural hospitals, Virginia (44%), South Carolina (37%), and Pennsylvania (29%) had the highest proportion of mergers.

Annually, rural mergers increased over 200% since 2010 (averaging 20 mergers/year from 2005-2010 and 44/year from 2011-2016).<sup>ii</sup> The increase in mergers during recent years is represented in Figure 2.2 by the higher proportion of darker red shaded squares. Further description of state-level distributions and annual occurrences can be found in other work from the authors.<sup>66</sup>

### Unadjusted Descriptive Statistics of Rural Hospitals Prior to Merger

In Table 2.1, we present descriptive statistics of rural hospitals in the year of analysis (year-1). Results represent differences in the pre-merger period between merged and non-merged rural hospital-years. The first column of data depicts averages for all (e.g., non-merged and



merged) rural hospital-years. The second data column depicts averages for non-merged rural hospital-years, and the third data column depicts averages for merged rural hospital-years.

### *Profitability*

Compared to non-merged rural hospitals, merged rural hospitals reported significantly lower pre-merger total margins.

### *Operational Efficiency*

By both measures of operational efficiency, FTEs per bed and CCR, merged rural hospitals were more efficient pre-merger than non-merged rural hospitals.

### *Capital Structure*

Compared to non-merged rural hospitals, a larger proportion of merged rural hospitals were significantly less likely to be able to pay existing debt in the pre-merger period.

### *Utilization*

The proportion of outpatient payer mix attributed to Medicare was four percentage points lower for merged, relative to non-merged, rural hospitals. Whether a rural hospital provided obstetric services pre-merger did not differ significantly between merged and non-merged rural hospitals.

### *Other Hospital Characteristics*

Relative to the comparison group, merged rural hospitals were more than twice as likely to be for-profit entities and less than half as likely to be government-owned. Compared to the same group, a larger proportion of merged rural hospitals reported older plant age. The unadjusted plant age finding was not statistically significant ( $p=0.07$ ) but showed a statistical trend and may have been of clinical importance. Merged rural hospitals, compared to non-merged rural hospitals, were significantly more likely to be among the largest quartile of rural hospitals and four times less likely to be among the smallest quartile of all rural hospitals in the

pre-merger period. Merged rural hospitals were much more likely to be non-CAH, PPS rural hospitals.

#### *Market Competitiveness*

Merged rural hospitals were significantly closer to the nearest large hospital than non-merged rural hospitals. The difference was sizeable, 9 miles. Merged rural hospitals captured a smaller proportion of total market share.

#### *Other Market Characteristics*

Merged rural hospital markets were nearly two times the size of non-merged rural comparators. Unemployment was nearly one percentage point higher in merged rural hospital markets than non-merged markets. While a high proportion of rural hospitals in general were in the south (35.51%), merged rural hospitals were disproportionately in the south (47.86%).

#### **Factors Associated with Rural Hospitals that Merged**

The relationship of key hospital factors with merging between 2005 and 2016 was determined using generalized estimating equations with a logit link and an exchangeable error term for repeated observations. Results are presented in Table 2.2.

#### *Profitability*

Controlling for other factors, an increase in total margin of one percentage point reduced odds of merging by 3%.

#### *Operational Efficiency*

After controlling for other factors, neither CCR or FTEs per bed was associated with the odds of merging in a statistically significant way.

#### *Capital Structure*

Compared to rural hospitals that could not afford current debt, being able to cover current debt reduced odds of merging by 36%.

### *Utilization*

After controlling for other factors, Medicare outpatient payer mix did not affect the odds of merging in a statistically significant way. Providing obstetrics services reduced the odds of merging by 44%.

### *Other Hospital Characteristics*

After controlling for other factors, for-profits had 76% higher odds of merging than not-for-profits; government-owned hospitals had 40% lower odds of merging than not-for-profits. Relative to rural hospitals that reported plant age amongst the newest quartile of all rural hospitals, hospitals with the oldest plant age had 62% higher odds of merging. The larger the hospital, the higher the odds of merger. Compared to rural hospitals amongst the smallest quartile of all rural hospitals, those in the largest quartile had 4.5 times the odds of merging. After controlling for other factors, CAH status was not associated with the odds of merging in a statistically significant way.

### *Market Competitiveness*

Controlling for other factors, an increase in logged miles between the merged rural hospital and the nearest large hospital reduced odds of merging by 22%. After controlling for other factors, market share captured was not associated with the odds of merging in a statistically significant way.

### *Other Market Characteristics*

After controlling for other factors, neither population or unemployment rate was associated with the odds of merging in a statistically significant way. Compared to rural hospitals located in the south, being in the west region reduced the odds of merging by 74%.

## Probability of Merging between 2005 and 2016 by Distance to Nearest Large Hospital and Ownership Type

We further investigated the relatively large unadjusted differences by merger status in distance and ownership status identified in Table 2.1 for two reasons. One, in studies of U.S. (e.g., not specifically rural) hospitals, proximity has been associated with acquirers' abilities to influence changes at target hospitals.<sup>67,68</sup> And two, for-profit hospitals have different financial objectives than other ownership types.<sup>52-55</sup> We expected the relatively large proportion of for-profit rural hospitals that merged to be closer to the nearest large hospital so the acquirer can influence changes at the target. Therefore, we determined the relationship of distance and ownership status with merging between 2005 and 2016. Unlike the descriptive statistics (Table 2.1) and regression model (Table 2.2), distance was categorized as <25 miles, 25-35 miles, and >35 miles to visually display differences in the relationship of distance and ownership status across policy-relevant categories. These categories were considered policy-relevant because of the potential impact of distance to the nearest hospital on CAH eligibility.<sup>iii</sup> Results are presented in Figure 2.3.

Closer, for-profit hospitals were more likely to merge than farther, not-for-profit or government-owned hospitals. As distance increased, the likelihood of merging fell for rural hospitals of all ownership types. The closest (e.g., <25 miles to the nearest large hospital) for-profits were 10.4 percentage points more likely to merge than the farthest for-profits (29.7% probability and 19.3%, respectively). No matter the distance, when compared to not-for-profits or government-owned hospitals, for-profits were more likely to merge. The farthest for-profits were more likely to merge than the closest not-for-profits (19.3% probability and 17.3%, respectively).

## Discussion

We identified several significant antecedents associated with rural hospitals that merged between 2005 and 2016. These factors included total margin, ownership status, ability to cover current debt, average plant age, size, whether a hospital provided obstetric services, distance to the nearest large hospital, and region.

In general, findings provided some support for our hypothesis that rural hospitals merge to improve financial performance and access capital while acquirers merge with rural hospitals to increase market power. Broadly, rural hospitals with worse financial performance had higher odds of merging. As total margin increased, odds of merging decreased. Merger odds were lower for rural hospitals that could afford to pay existing debt, compared to those that could not. These findings were consistent with Noles et. al., who showed rural hospitals with higher total margins and a larger proportion of equity financing were less likely to merge.<sup>15</sup> Results from our study and prior research suggested rural hospitals in worse financial standing were more likely to merge. Operating older facilities was associated with higher odds of a rural hospital merging. Rural hospitals with these characteristics may have merged to improve profits, payoff existing debt, and/or access capital to replace aging facilities.

Rural hospitals that were closer to the nearest large hospital and larger had higher odds of merging. In separate (unreported) work, we evaluated distance for patients in a rural hospital's market (rather than the rural hospital itself) to the nearest large hospital and found similar, statistically significant differences in miles to the nearest large hospital by merger status. Both distance findings suggested proximity to the nearest large hospital increased the odds of merging. Our findings are consistent with previous work that found proximity, measured between target hospital and the nearest large hospital, was associated with a higher likelihood of U.S. hospitals merging.<sup>13,14</sup> However, inference to these studies should be limited due to differences in samples

(e.g., we evaluated only rural hospitals, these studies evaluated a combination of rural and non-rural hospitals) and time periods (e.g., our sample was 2005 through 2016, Harrison's sample was 1981-1998, Dranove and Lindrooth's was 1988-2000).<sup>13,14</sup>

One explanation for our proximity finding could have been that those rural hospitals were appealing targets for acquirers seeking to increase market power. Various measures of proximity have been shown to affect acquirers' abilities to make post-merger operational changes at targets.<sup>23,29,62</sup> While proximity is linked to higher post-merger prices at merged U.S. hospitals (e.g., not specifically rural),<sup>21</sup> those increases have also been shown to dissipate as proximity decreases.<sup>67</sup> Cooper et. al. found target U.S. hospitals significantly increased post-merger prices when merging entities were geographically close (e.g.,  $\leq 5$  miles apart) but did not increase prices for hospitals that were geographically distant (e.g.,  $> 25$  miles apart).<sup>67</sup> However, hospitals in Cooper et. al.'s sample generally operated in highly competitive markets, with over 50% operating markets with three or more competitors.<sup>67</sup> A disproportionately low 16% of hospitals in Cooper et. al.'s sample were rural.<sup>67</sup> Rural hospitals typically operated in less competitive markets.<sup>69</sup> Therefore, the association between proximity and post-merger price changes may differ at rural hospitals. Different mileage thresholds, such as those we evaluated around CAH-eligibility mileage, may be more relevant to contextualize those changes. In our sample, 60% of rural hospitals were more than 25 miles from our proximity measure. Future work should consider the potential impact of proximity on post-merger changes at rural hospitals and how that impact may differ between rural and non-rural hospitals. Such work could be helpful for decision-makers addressing post-merger changes at rural hospitals.

We found for-profit rural hospitals had significantly higher odds of merging than not-for-profits or government-owned hospitals. This finding contradicted a previous finding from

Harrison that not-for-profit U.S. hospitals were more likely to merge, particularly with other not-for-profits.<sup>14</sup> It is possible findings varied due to differences in studies, (e.g., samples and time periods). It is possible that a replication of Harrison's study in today's environment would find a shift in the impact of ownership status on merging U.S. hospitals that reflects our findings for rural mergers. We explored potential differences by comparing ownership-status of all U.S. hospitals for a period of Harrison's study to ours and found, in general, for-profit ownership of rural and non-rural hospitals has increased over the past two decades.<sup>34</sup> For-profits have different financial objectives, relative to other ownership types,<sup>52-55</sup> which may be associated with an increase in for-profit ownership and with faster decision-making that led to more for-profit hospitals mergers, regardless of rurality. Another potential explanation for differences between studies could be that more for-profit rural hospitals merged than for-profit non-rural hospitals. During the sample period, one of the largest for-profit rural hospital owners, Community Health Systems (CHS) divested most of its rural hospitals to reduce debt and ultimately, improve cash flow and profits.<sup>70</sup> Since several of our findings suggested financially constrained rural hospitals with higher debt loads had greater odds of merging, many for-profit rural hospitals could have merged during the sample period as part of a for-profit sell-off.

Larger rural hospitals had higher odds of merging. This could be consistent with Harrison's finding that U.S. hospital acquirers and targets were of similar size.<sup>14</sup> We did not assess if merged rural hospitals were of similar size to the acquirer. However, rural hospitals were generally much smaller than non-rural hospitals; therefore, it is possible that the largest rural hospitals were closer in size to acquirers.

We did not identify statistically significant associations of several factors with merging. These factors included Medicare CCR, FTEs per bed, market share captured, population, and

unemployment rate. Further research is warranted to better understand value-creating antecedents associated with rural hospital mergers.

### **Implications**

Findings contributed to the literature in at least four meaningful ways. One, we identified *which* rural hospitals merged. Two, we determined *when* rural hospitals merged. The Levin data's announcement date was essential to identify rural hospitals that potentially merged. However, we expected our effective date would be more precise to determine associations of time-varying antecedents with whether rural hospitals merged than the announcement date because it captured the same moment of ownership transfer at every merged hospital. The average announcement date occurred 109 days prior to the effective date. However, the announced date did not always precede the effective date. Five percent of announced dates followed the effective date. Nineteen percent of announced and effective dates were the same. Because we evaluated mergers at discrete time periods (e.g., relative to the hospital fiscal year (HFY)), differences in dates were only relevant if the announced date did not occur in the correct HFY. Had we evaluated rural mergers using the HFY associated with the announced date rather than the effective date, we would have evaluated different HFYs 64% of the time. We tested for the effect of the difference in announced and effective dates on findings by performing separate (unreported) analyses using the announced date instead of the effective date and determined there were statistically significant differences between models. It is likely that the model using the announced dates introduced measurement error that attenuated estimates towards the null. In the future, researchers should consider the potential for divergent findings based on how merger dates are measured.

Three, we described unadjusted characteristics of rural hospitals that merged and compared those characteristics to non-merged rural hospitals. Four, we determined whether



several value-creating antecedents were associated with whether rural hospitals merged using multivariate regression and controlling for relevant factors. Differences in the unadjusted descriptive statistics (Table 2.1) and adjusted regression estimates (Table 2.2) highlighted the importance of the latter estimates for accurately determining antecedents associated with whether rural hospitals merge.

Findings from this study expanded our understanding of rural hospital merger antecedents. Similar to previous work, we found performing worse financially was associated with higher odds of merging.<sup>15</sup> We added to what was previously known by determining several other value-adding antecedents, like the association of older plant age with merging. Therefore, financially fragile rural hospitals may have merged to access capital for facility renovations and replacements. In future work, we will determine whether rural hospitals increase capital expenditures in the post-merger period.

Our findings also suggested what was previously known about U.S. hospital merger antecedents may not be generalizable to rural hospitals. We found for-profit rural hospitals were more likely to merge, whereas prior work found not-for-profit U.S. hospitals were more likely to merge, particularly with other not-for-profits.<sup>14</sup> Also, we linked proximity with rural hospitals merging, which was consistent with prior U.S. hospital merger findings.<sup>13,14</sup> However, a more detailed look at proximity and post-merger changes (e.g., prices)<sup>67</sup> led us to question whether unique differences between rural and non-rural hospital proximity may have impacted post-merger outcomes at rural hospitals in unknown ways. Researchers could determine whether baseline differences lead to divergent impacts on rural, relative to non-rural, hospitals. Such findings might impact how policy-makers address legislation that impacts merger activity and health care in rural communities.

## **Conclusion**

We found rural hospitals with higher odds of merging between 2005 and 2016 were less profitable, for-profit, larger rural hospitals that had less ability to cover current debt, reported older plant age, did not provide obstetrics, were closer to the nearest large hospital, and were not in the West. By quantifying the hazard of characteristics associated with whether rural hospitals merged between 2005 and 2016, these findings suggest it is possible to determine leading indicators of rural mergers. Our results may serve as a foundation for future research to determine the impact of mergers on rural hospitals.

## **Limitations**

This sample includes only hospitals that met our definition of a merger. Thus, system affiliations and other integration models between two hospitals were not addressed. Failing to identify non-merged affiliations could have attenuated coefficients towards the null because hospitals involved in non-merged affiliations were considered non-merged in these analyses, though these hospitals may have had similar pre-merger characteristics to hospitals that merged.

Generalized estimating equations were limited to population-level average interpretations. Therefore, associations could not be interpreted for specific hospitals. This was an acceptable limitation because an objective of this work was to inform decision-makers of national average merger determinants.

## ENDNOTES

<sup>i</sup> For this research, hospital mergers occurred when an acquiring entity (acquirer) took majority ownership of another hospital (target). In most mergers, one organization (the acquirer) initiated action to take over another (the target).

<sup>ii</sup> The average annual number of rural hospital mergers was based on the *total* number of rural mergers (379) between 2005 and 2016. That number included each merger for any rural hospital that merged more than once. We chose the *total* number of mergers for annual averages rather than the number of *unique* rural hospitals that merged to account for rural hospitals that merged more than once in the two time periods we classified (e.g., 2005-2010 and 2011-2016).

<sup>iii</sup> Hospitals must meet certain criteria to be eligible for the Critical Access designation. Most hospitals must be located in a rural area, be more than a 35-mile drive to the next hospital, and maintain no more than 25 inpatient beds (with certain allowable exceptions).<sup>59</sup>

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**Figure 2.1: Merger Antecedents, Moderators, and Outcomes**

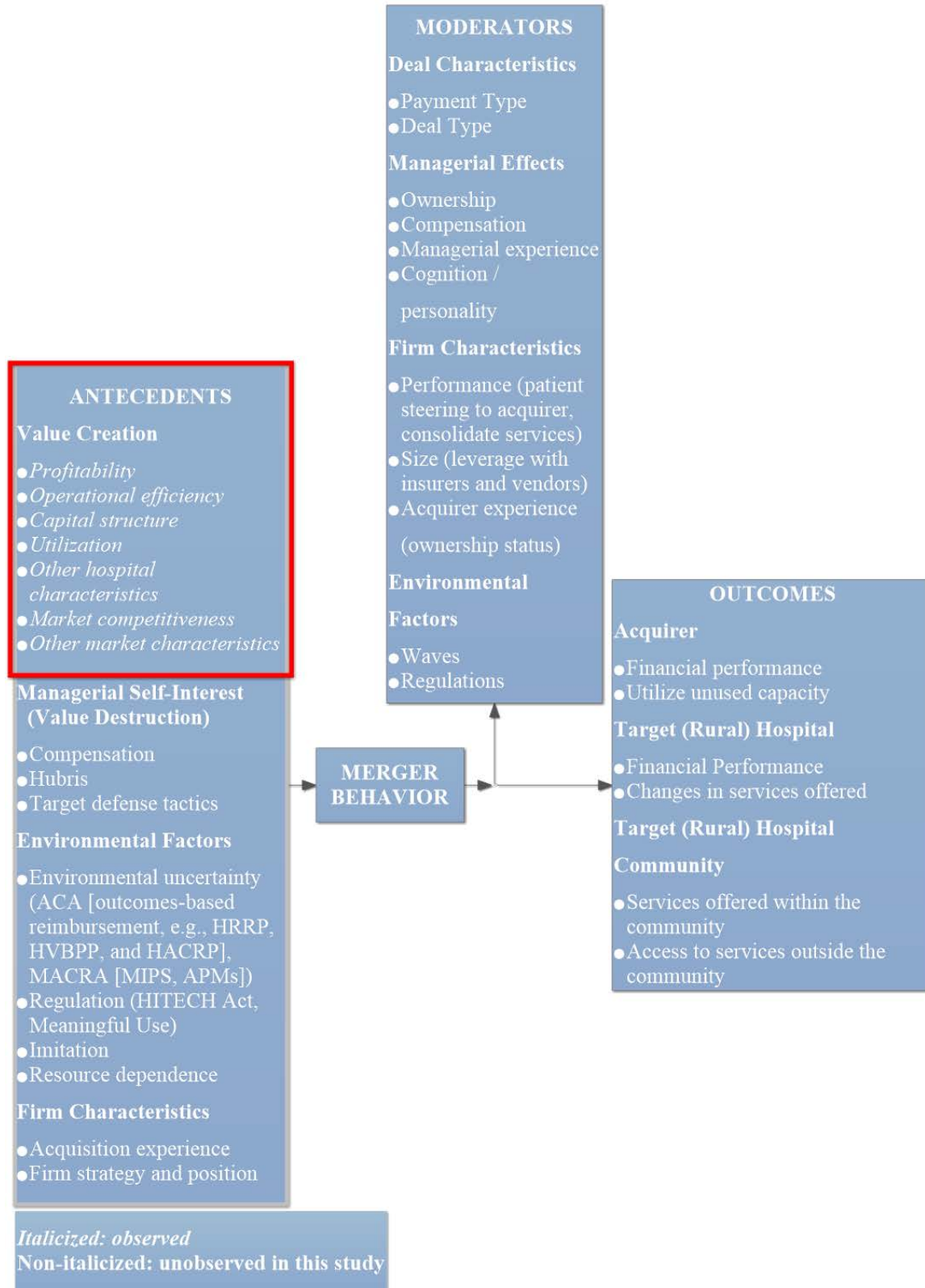
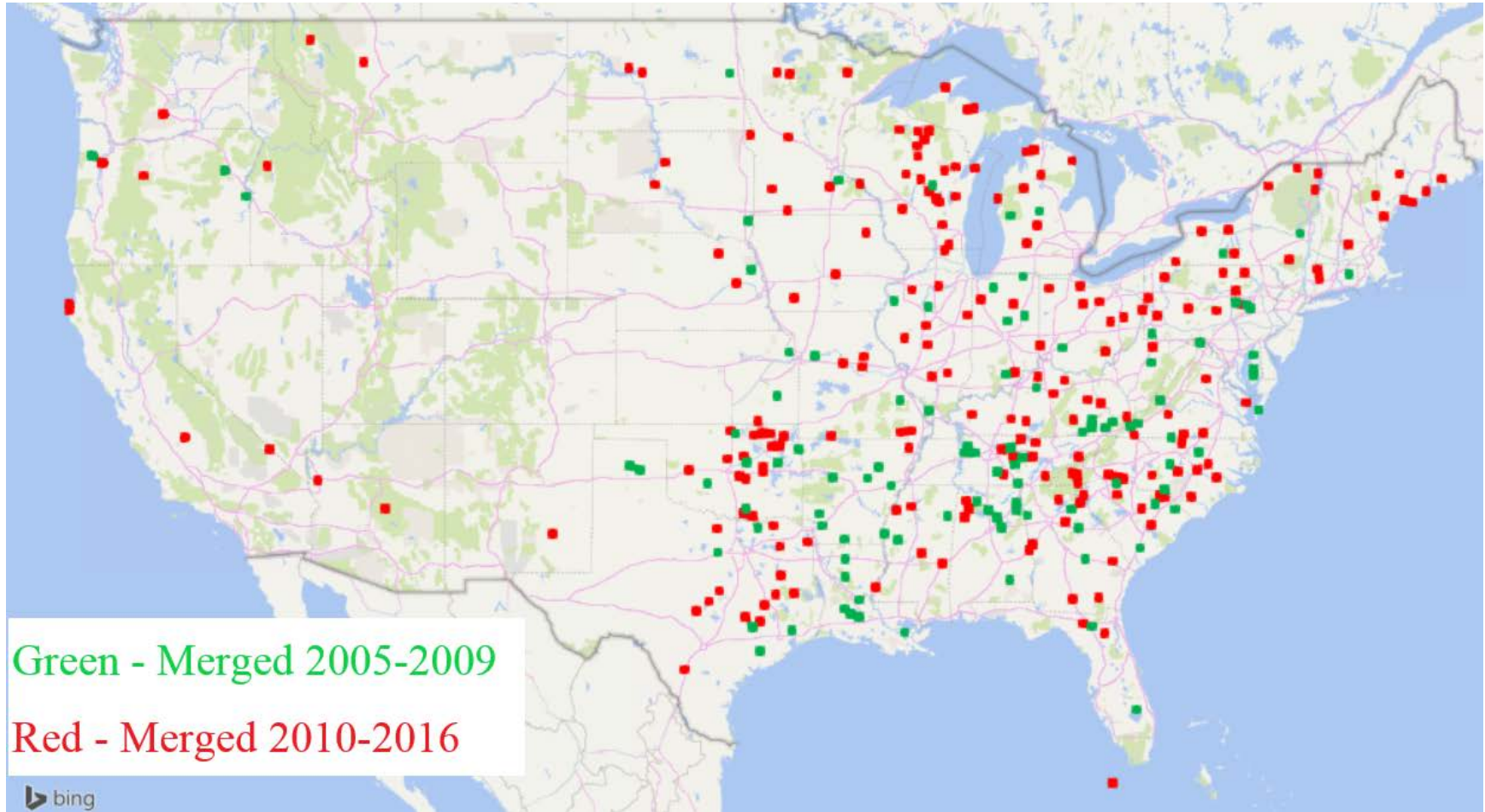


Figure 2.2: Geographic Distribution of Rural Hospitals that Merged between 2005 and 2016



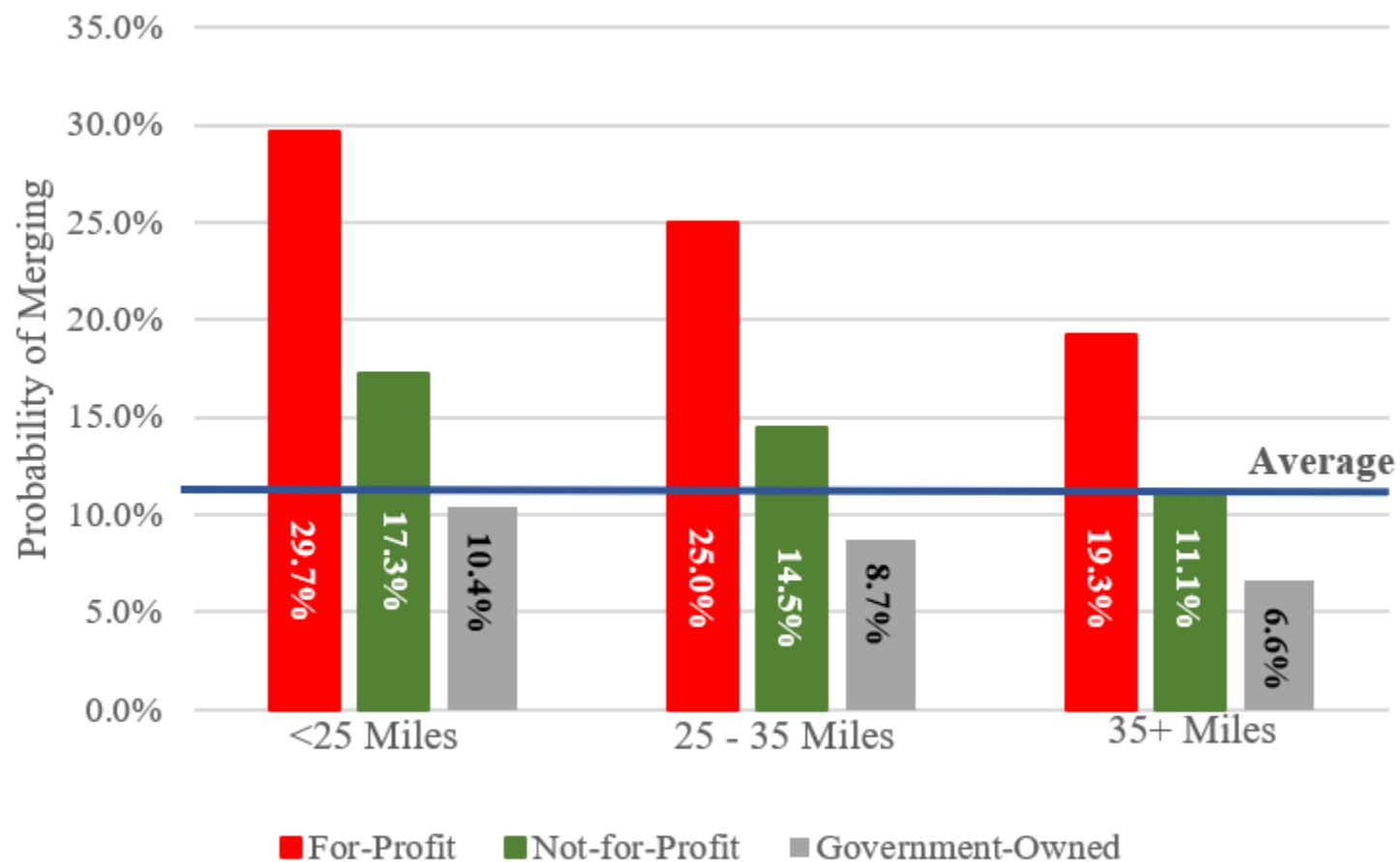
**Table 2.1: Rural Hospital Averages for Analysis Year (Year Immediately Prior to Merger)**

Variable	All Hospitals (N=25,065)	Non-Merged Hospitals (N= 24,783)	Merged Hospitals (N= 282)	p
	Average (Standard Deviation) or %			
<i>Profitability</i>				
Total Margin (%)	2.73 (9.39)	2.73 (9.34)	2.37 (11.71)	<0.001***
<i>Efficiency</i>				
FTEs per Bed	5.56 (5.27)	5.58 (5.29)	4.52 (2.96)	<0.001***
Medicare CCR (%)	38.97 (19.10)	39.30 (19.11)	28.91 (14.32)	<0.001***
<i>Capital Structure</i>				
Ability to Cover Current Debt (%)				<0.001***
Did Not Report DSCR	21.88	21.66	34.19	
Unable to Cover Current Debt	17.31	17.27	19.84	
Able to Cover Current Debt	60.81	61.08	45.96	
<i>Utilization</i>				
Medicare Outpatient Payer Mix (%)	32.14 (11.38)	32.27 (11.40)	28.10 (9.23)	<0.001***
Hospital Provides Obstetrics (%)				0.32
Does Not Provide Obstetrics	43.81	43.88	40.01	
Provides Obstetrics	56.19	56.12	59.99	
<i>Other Hospital Characteristics</i>				
Ownership Status (%)				<0.001***
Not-for-Profit	54.6	54.38	66.66	
For-Profit	7.28	7.08	18.81	
Government	38.12	38.54	14.53	
Average Plant Age (% , quartiles)				0.07
Percent in Newest Quartile	22.79	22.89	17.22	
Percent in Second Newest Quartile	25.47	25.55	20.92	
Percent in Second Oldest Quartile	25.69	25.58	32.12	
Percent in Oldest Quartile	26.05	25.98	29.74	
Size (Net Patient Rev, quartiles)				<0.001***
Percent in Smallest Quartile	22.98	23.28	5.80	
Percent in Second Smallest Quartile	26.15	26.22	22.10	
Percent in Second Largest Quartile	24.37	24.25	30.84	
Percent in Largest Quartile	26.51	26.24	41.26	
CAH Status (%)				<0.001***
Non-CAH, PPS	48.72	48.40	67.10	
CAH	51.28	51.60	32.90	
<i>Market Competitiveness</i>				
Distance to Nearest Large (>100 bed) Hospital (miles)	33.45 (29.50)	33.68 (29.66)	24.65 (18.16)	<0.001***
Market Share (cases) Captured (%)	24.64 (12.20)	24.67 (12.23)	23.70 (10.76)	0.003**
<i>Other Market Characteristics</i>				
Market Total Population (millions)	3.24 (5.70)	3.20 (5.68)	6.02 (6.25)	<0.001***
Market Unemployment Rate (%)	7.49 (3.46)	7.48 (3.47)	8.26 (3.07)	<0.001***
Region (%)				<0.001***
Northeast	7.04	6.94	1.26	
Midwest	38.94	38.98	36.83	
South	35.51	35.29	47.86	
West	18.51	18.79	14.05	
Average is the median for continuous variables, mean for non-continuous variables.				
P-values by t-test for continuous variables and chi <sup>2</sup> test for binary / categorical variables				
* p<0.05, ** p<0.01, *** p<0.001				
Standard Deviation in Parentheses				
Missing values: Total Margin (104 obs) CCR (48 obs) FTEs per Bed (115 obs) Plant Age (1,064 obs) Size (41 obs) Outpatient Payer Mix (26 obs) Distance (64 obs) Market Share (64 obs) Population (64 obs) Unemployment Rate (64 obs)				

**Table 2.2: Factors Associated with Rural Hospitals in the Year Prior to Merger (2004 – 2015)**

Variable	Odds Ratio	95% CI	Variable	Odds Ratio	95% CI
(N=23,894)					
<i>Profitability</i>			<i>Market Competitiveness</i>		
Total Margin (%)	0.97***	(0.95-0.98)	Distance to Nearest Large (>100 bed) Hospital (logged miles)	0.78*	(0.65-0.95)
<i>Efficiency</i>			<i>Other Market Characteristics</i>		
FTEs per Bed	0.97	(0.92-1.02)	Market Share (cases) Captured (%)	1.00	(0.99-1.02)
Medicare CCR (%)	0.99	(0.98-1.00)	Market Total Population (logged)	1.2	(0.91-1.58)
<i>Capital Structure</i>			Market Unemployment Rate (%)		
Ability to Cover Current Debt (%)			Region (%)	0.99	(0.94-1.04)
Unable to Cover Current Debt (ref)			South (ref)		
Able to Cover Current Debt	0.64*	(0.45-0.93)	Midwest	1.06	(0.70-1.61)
<i>Utilization</i>			Northeast		
Medicare Outpatient Payer Mix (%)	0.99	(0.97-1.01)	West	0.26**	(0.11-0.64)
Hospital Provides Obstetrics (%)			Constant	0.0023***	(0.0001-0.0919)
Does Not Provide Obstetrics (ref)					
Provides Obstetrics	0.56***	(0.40-0.80)			
<i>Other Hospital Characteristics</i>					
Ownership Status (%)					
Not-for-Profit (ref)					
For-Profit	1.71*	(1.01-2.88)			
Government	0.60**	(0.40-0.88)			
Average Plant Age (% , quartiles)					
Percent in Newest Quartile (ref)					
Percent in Second Newest Quartile	1.28	(0.85-1.93)			
Percent in Second Oldest Quartile	1.53*	(1.00-2.34)			
Percent in Oldest Quartile	1.62*	(1.03-2.53)			
Size (Net Patient Rev, quartiles)					
Percent in Smallest Quartile (ref)					
Percent in Second Smallest Quartile	2.20*	(1.12-4.00)			
Percent in Second Largest Quartile	3.40***	(1.74-6.64)			
Percent in Largest Quartile	4.50***	(1.98-10.22)			
CAH Status (%)					
Non-CAH, PPS (ref)					
CAH	1.15	(0.74-1.78)			
* p<0.05, ** p<0.01, *** p<0.001					
Missing values: Total Margin (104 obs) CCR (48 obs) FTEs per Bed (115 obs) Plant Age (1,064 obs) Size (41 obs) Outpatient Payer Mix (26 obs) Distance (64 obs) Market Share (64 obs) Population (64 obs) Unemployment Rate (64 obs)					

Figure 2.3: Probability of Merging between 2005 and 2016 by Distance to Nearest Large Hospital and Ownership Type



## **CHAPTER 3. STUDY 2 PAPER: FOR RURAL HOSPITALS THAT MERGED: INPATIENT CHARGES DECREASED, OUTPATIENT CHARGES INCREASED**

*A Pre/Post Comparison of Rural Hospitals that Merged and Rural Hospitals that Did Not Merge  
between 2005 and 2015*

### **Overview**

#### **Objective**

To determine whether inpatient and outpatient charges changed at rural hospitals after a merger.

#### **Data Sources**

Hospital merger status was derived from proprietary Irving Levin Associates data and hospital-level characteristics were derived from HCRIS, CMS Impact File Hospital Inpatient Prospective Payment System, Hospital MSA file, AHRF, and U.S. Census data.

#### **Study Design**

A difference-in-differences approach was used to determine whether inpatient and outpatient charges changed at rural hospitals after a merger. The comparison group, rural hospitals that did not merge at any point during the sample period, was weighted using inverse probability of treatment weights. Key outcome measures were inpatient and outpatient charges (logged). To contextualize the implications of changes in inpatient and outpatient charges, four additional outcomes were evaluated: total inpatient discharges, acute bed average daily census (ADC), total revenue, and net patient revenue (NPR).

## **Principal Findings**

Compared to non-merged rural hospitals, those that merged billed 17.73% more inpatient charges and 12.66% more outpatient charges at baseline. Difference-in-differences estimates showed that merging was associated with a 3.04% decrease in inpatient charges ( $p < 0.001$ ) and a 1.07% increase in outpatient charges. While the outpatient difference-in-differences estimate ( $p = 0.082$ ) was not statistically significant at  $p < 0.05$ , it showed a statistical trend and may have been of clinical importance. Merging was also associated with a 4.38% decrease in total revenue, a 3.58% decrease in NPR, and no change in total inpatient discharges or ADC.

## **Conclusions**

Merging was strongly associated with a decrease in inpatient charges and somewhat associated with an increase in outpatient charges for rural hospitals. Additionally, merging was associated with a decrease in total revenue and NPR but no change in total discharges or ADC.

## **Implications**

It is possible that a post-merger decrease in inpatient charges and revenue with no change in inpatient volumes was associated with a post-merger decrease in inpatient service offerings and/or complexity at the merged rural hospital. However, the extent and significance of any service changes is unclear from these findings. Future work could build upon this work to determine whether acquirers reduce or eliminate certain services at rural hospitals after a merger, and ultimately how changes in service delivery could impact patients in those rural communities.

## **Introduction**

A wave of rural hospital mergers is transforming the health care landscape in rural America. To thrive (or survive) amidst decreasing inflation-adjusted reimbursement rates<sup>1</sup> and environmental pressures to consolidate resources,<sup>2,3</sup> hospitals must become more efficient<sup>4</sup> while simultaneously improving health outcomes.<sup>3</sup> Succeeding in the current health care environment



can be especially difficult for rural hospitals that, compared to non-rural hospitals, serve more vulnerable populations with worse health outcomes, provide smaller volumes of care and less specialty services, and are more likely to be financially distressed.<sup>5-11</sup> In response to these pressures, many rural hospitals may be targeted in a merger by larger hospitals or system acquirers. Acquirers may be interested in merging with rural targets because rural hospitals typically have few competitors in their rural markets.<sup>5,6</sup> Thus, through a merger, acquirers could increase their market power and become the largest health care providers in target rural communities. Studies have shown that, after a merger, acquirers may coordinate care across sites by steering patients from the target<sup>i</sup> to the acquirer,<sup>i,12,13</sup> reduce costs by consolidating staff and the number of sites providing the same care,<sup>10,14</sup> and, ultimately, improve outcomes-based reimbursement.<sup>10</sup>

Since 2011, a total of 261 rural hospitals merged, compared to 118 between 2005 and 2010.<sup>15</sup> As the number of rural hospital mergers continues to rise, it is important to understand what happens to these hospitals afterward. Existing research identified specific post-merger changes in services provided at target hospitals. Known service delivery changes at target hospitals include decreases in inpatient admissions,<sup>3,16,17</sup> occupancy,<sup>18</sup> outpatient visits,<sup>17</sup> and emergency room visits.<sup>3</sup> Yet, the relationship between mergers and changes in services provided at *rural* hospitals is largely unknown. The only known study to evaluate changes in rural hospital services due to a merger found no significant change in nursery days or skilled nursing facility (SNF) days and no shift from inpatient to outpatient care – as measured by the percent of total revenue derived from outpatient services.<sup>19</sup> In this study, the impact of merging on inpatient and outpatient charges at rural hospitals after merging is measured to explore potential service changes.

A specific focus on rural hospitals is important because post-merger changes in services provided at rural hospitals could have significant impacts on rural communities. These impacts may be nuanced, consisting of a mix of positive and negative changes in access, quality, and cost of care. Rural communities are vulnerable to changes because their residents are, on average, poorer, older, sicker, and comprised of higher proportions of uninsured and government-insured patients<sup>5,6</sup> than non-rural communities. Additionally, life expectancy and numerous other health outcomes are worse for rural residents, compared to non-rural residents – and those gaps have widened in recent decades.<sup>20</sup> Therefore, rural residents may be particularly sensitive to potentially negative post-merger changes in services provided within the community. A reduction in inpatient services may leave fewer provider alternatives and increase distance-to-care for rural community members.<sup>21,22</sup> Research suggests that longer distance-to-care negatively affects the likelihood to receive care, prognosis, quality of life, and ultimately, health outcomes.<sup>23</sup>

Services changes due to a merger could also lead to positive effects on health care in rural communities. For many financially distressed rural hospitals,<sup>7</sup> a merger may bring operational changes that stabilize financial performance,<sup>24,25,26</sup> allowing the rural hospital to remain in business and continue providing some volume and level of services within the community. Since rural hospitals are often the largest employers in the communities they serve,<sup>27</sup> avoiding closure could be important for maintaining jobs and supporting the local rural economy. Service line consolidation<sup>14</sup> may allow rural hospitals to refocus service offerings to fit the needs of community members. Quality of care may improve for certain inpatient surgeries and care, where scaling services has been shown to improve quality.<sup>19,4,28</sup>

This study identifies the merger status of rural U.S. hospitals between 2005 and 2015 and uses a proprietary hospital data set, combined with other data sources, to determine whether inpatient and outpatient charges changed at rural hospitals after a merger. We hypothesize that acquirers use a merger to decrease inpatient charges and increase outpatient charges at the target. Doing so could be one indicator that mergers lead to a shift from inpatient to outpatient services provided by rural hospitals.

## **Methods**

### **Data Sources**

We combined multiple secondary data sources to form a panel for years 2003-2016. Hospital-level characteristics were combined from HCRIS “cost report” data, the CMS Impact File Hospital Inpatient Prospective Payment System, the Hospital MSA file, the AHRF, and U.S. Census data. Data from hospital-reported cost report fiscal years (HFYs) was combined with a hospital’s merger status. A hospital’s merger status was derived from proprietary data found in the “The Health Care Services Acquisition Report” by Irving Levin Associates for 2005–2016.

### **Study Design**

We estimated difference-in-differences models for two outcomes (inpatient and outpatient charges). The difference-in-differences estimators compared pre/post merged rural hospitals to pre/post non-merged rural hospitals. The difference-in-differences models controlled for unobservable differences between rural hospitals that merged and those that did not merge that are expected to remain stable over time. One example of an unobservable difference could be a need for hospital services within the community.

To determine whether and when a rural hospital merged, we began with the Levin data. The Levin data report a merger “announcement date,” which may have: 1) included hospitals that did not merge during the sample period and 2) represented a date other than that on which

ownership transferred. To verify when and whether an “announced” merger occurred, we created an “effective” date through searching publicly-available documents online (e.g., for-profit IRS Form 10-Ks, not-for-profit IRS Form 990s, and annual reports from hospital websites) and, when necessary, calling and emailing leaders of rural hospitals. This process is further described in other work by the authors.<sup>15</sup> Rurality was defined according to the criteria specified by the Federal Office of Rural Health Policy and other federal programs.<sup>29</sup>

Because we analyzed data by discrete years, not specific dates within a year, it was necessary to align effective<sup>ii</sup> merger dates with the correct HFY. Doing so was essential to compare hospital data from the correct time period because the HFY differed from the calendar year of the effective date approximately two-thirds of the time.<sup>30</sup>

We excluded partial-year data reported for less than 360 days<sup>31</sup> and data that did not include positive values for the outcome measure. We limited our analysis to the first merger during the study period. Control hospitals were rural hospitals that did not merge during the sample period (2005-2016). Non-merged controls were included as many times as there was complete data.

#### *Weighting Non-Merged Rural Hospitals*

Inverse probability of treatment weights (IPTWs) were applied to addresses suspected selection bias around which rural hospitals merged. Weights created a pseudo-population under which the group of merged rural hospitals more closely resembled the group of non-merged control hospitals. Weights were based on the same independent variables specified in the subsequent “Control Variables” section, a process often described as “doubly-robust.”<sup>32</sup> Doubly-robust estimation has been described as a preferred measure to address selection bias because it provides two opportunities to address model misspecification based on observable characteristics.<sup>32</sup> After applying IPTWs, baseline variables were balanced across comparison

groups such that standardized differences were <10%.<sup>33</sup> One potential concern in our analysis was that hospitals reporting years of unusually weak financials may merge. Such an occurrence may have led to an overestimate of the “effect” of merging due simply to regression to the mean, sometimes referred to as an Ashenfelter Dip.<sup>34,35</sup> In this case, rural hospitals may have merged in response to recent outcomes, such as low patient volumes, unsustainable fixed costs, and poor revenue in the year immediately prior to a merger. Therefore, we weighted based on data from two years prior to merger.

#### *Analytical Years*

To be included in this analysis, hospitals must have reported three years of full-year cost report data: the year prior to merger, the year following merger (to compare pre/post differences), and two years prior to merger (to weight controls). The year of merger (transition year) was excluded from analyses. We compared merger activity in the year immediately prior to merger (pre-merger) and the year immediately after merger (post-period).

In the Appendix 2, we show the process for which and when data was used for a rural Oklahoma hospital that merged in 2007. Full-year cost report data for that hospital and its weighted controls was required for HFYs 2005, 2006, and 2008 (Appendix 2, blue years). To model the pre/post difference in rural hospitals that merged, data was necessary for HFYs 2006 and 2008. To weight similar control hospitals, data was also required for HFY 2005. Because hospitals were limited to the first merger during the sample period, any subsequent mergers of the Oklahoma hospital were excluded (Appendix 2, bottom left image). However, non-merged controls could have been included in the comparison group as many as eleven times, with eleven different weights that aligned with the comparison merged hospitals’ FYs (Appendix 2, bottom right image).

We cleaned data for completeness using complete case analysis (CCA) and addressed extreme values by Winsorizing<sup>36</sup> (censoring) those values at the one percent tails of each variable's distribution.<sup>37</sup> Descriptive statistics were weighted by two factors: 1) the annual proportion of merged hospitals relative to all mergers and 2) days in period (DIP). For example, 6 of the 208 merged hospital-years occurred in 2005. Therefore, descriptive statistics for merged and non-merged hospital-years for 2005 were weighted as 6/208<sup>th</sup>s of the overall means/medians. Statistics were then weighted at the hospital year-level for DIPs. Differences between groups were tested using Pearson's chi-square (categorical variables) and Wilcoxon rank test of medians (continuous variables) using 0.05 as the probability of Type 1 error.

### **Study Sample**

There were 297 unique rural hospitals that merged between 2005 and 2015 in our sample, though only 208 reported the data necessary for us to conduct our analyses. The final sample consisted of 38,148 observations, 416 of which were associated with a merger and 37,732 of which were not. Because of the pre/post comparison, the final sample consisted of 208 merged hospital-years ( $416/2=208$ ) and 18,866 non-merged hospital-years ( $37,732/2$ ) (Figure 3.1).

### **Study Variables**

#### *Key Dependent Variables*

We measured two key outcomes: inpatient charges and outpatient charges. Both variables were measured as total charges before deductions and logged because of skewed distributions. Inpatient charges was derived from cost report worksheet G-2, column 1, line 28. Outpatient charges was derived from cost report worksheet G-2, column 2, line 28.

#### *Additional Dependent Variables*

To contextualize the implications of changes in inpatient and outpatient charges on services, we estimated four additional models on total inpatient discharges, acute bed average

daily census (ADC), total revenue, and net patient revenue (NPR). Total inpatient discharges, total revenue, and NPR were logged because of skewed distributions. Total inpatient discharges was derived from cost report worksheet S-3, part 1, column 15, line 1. ADC was derived from cost report worksheet S-3, column 8, lines (14 minus 5 minus 6 minus 13)/DIP. Total revenue was derived from worksheet G-3, column 1, lines 3 plus 25. NPR was derived from worksheet G-3, column 1, line 3.

### *Key Independent Variables*

The difference-in-differences parameter estimates determined the difference in hospital outcomes attributed to merging between merged and weighted non-merged rural hospitals (difference 1) and between pre-merged and post-merged periods (difference 2).

### *Control Variables*

Hospital characteristics included ownership,<sup>38,39,40</sup> CAH status,<sup>11</sup> whether a hospital provided obstetrics services, outpatient cost to charge ratio (CCR),<sup>41</sup> and FTEs per bed.<sup>10</sup> Ownership – categorized as private for-profit, private not-for-profit, and government-owned – controlled for differing financial objectives.<sup>42-45</sup> CAH status controlled for Medicare cost-based reimbursement.<sup>11</sup> Whether a rural hospital provided obstetric services controlled for a specific inpatient service line that may change due to a merger. Between 2004 and 2014, the number of rural hospitals providing obstetrics fell by more than 7%.<sup>46-48</sup> A hospital was considered to have obstetrics if at any point during the sample period (2003 – 2016), the hospital 1) reported offering obstetric services in OSCAR data and 2) reported obstetric charges >\$10,000 in at least one cost report. Medicare outpatient CCR controlled for potential differences in billing and/or cost inefficiencies.<sup>49</sup> FTEs per bed<sup>49</sup> controlled for potential differences in patient volumes and/or staff productivity.

Market characteristics included distance to the nearest large (e.g., >100 bed) hospital, market share captured, total population,<sup>37</sup> unemployment rate,<sup>50,51</sup> and region.<sup>52</sup> Hospital market areas are created using Medicare discharge counts by ZIP code from the CMS Hospital Service Area File. A ZIP code is included in the market if, when sorted in descending number of that hospital's Medicare discharges, it is among the ZIPs that comprise the first seventy-five percent of that hospital's Medicare discharges<sup>53</sup> or if it contributes at least three percent of that hospital's Medicare admissions for the year. Except for hospitals in Alaska and Hawaii, ZIP codes more than 150 miles from the hospital are disqualified from being in its market. The market areas are not specified to be mutually exclusive, exhaustive, or contiguous. Low-population or low Medicare population ZIP code areas in otherwise dense areas are more likely to be excluded from a market based on this definition.

Distance to the nearest large (e.g., >100 bed) hospital (logged miles), controlled for proximity to other hospitals. Proximity has been associated with acquirers' abilities to implement changes at targets due to distance.<sup>25,54,55</sup> While the nearest large hospital was not always the acquirer, this research was limited by not knowing the acquirer. Therefore, distance was measured to the nearest large hospital. Market share captured, measured as the proportion in inpatient discharges captured within a hospital's market, controlled for market competition. Population (logged) controlled for market size.<sup>11</sup> Unemployment rate controlled for local economic conditions.<sup>11</sup> Region controlled for potential unobserved geographic differences. Year fixed effects control for unobserved correlation of year-specific effects. DIP controlled for differences due to the number of days in the data reporting period.



## Results

### Descriptive Statistics of Rural Hospitals by Merger Status, Pre/Post-Merger (2004-2016)

In Table 3.1, we present descriptive statistics of rural hospitals by merger status and time. The first two columns depict rural hospital-year averages in the pre-merger period by merger status. The third and fourth columns display the same information by merger status but for the post-merger period. The fifth and sixth columns represent differences in the post- and pre-merger periods by merger status. The far-right columns present the unadjusted difference in time periods and merger status (unadjusted difference-in-differences) and, when significant, p-values. Note, averages for control measures were presented in previous work by the authors that, to date, has not yet been published. That work evaluated a different population of merged rural hospitals, which explains potential differences between averages presented in both papers.

#### *Inpatient and Outpatient Charges*

In both the pre- and post-periods and compared to non-merged rural hospitals, rural hospitals that merged at some point during the study period billed nearly three times more inpatient charges and over twice as much outpatient charges. However, relative to the pre-period, merged rural hospitals decreased inpatient charges post-merger while non-merged rural hospitals increased inpatient charges. The unadjusted difference-in-differences for inpatient charges was significant ( $p < 0.01$ ) and non-trivial (\$2,338,000). Both merged and non-merged rural hospitals grew outpatient charges in the post-period, relative to the pre-period. The unadjusted difference-in-differences for outpatient charges was not statistically significant at  $p < 0.05$ .

Unadjusted difference-in-differences for inpatient and outpatient charges are depicted visually in Figure 3.2 across a four-year period. The vertical red line in that figure denotes the year in which a merger occurred. While inpatient charges appears relatively flat with a slight

increase for non-merged hospitals, inpatient charges decreased post-merger for merged hospitals. Outpatient charges increased for both groups over time.

#### *Hospital Characteristics*

In both the pre- and post-periods and compared to non-merged rural hospitals, merged rural hospitals were more likely to be non-government-owned, non-CAH PPS hospitals with a lower cost-to-charge ratio and fewer FTEs per bed. The only statistically significant unadjusted hospital-level difference-in-difference was that more merged hospitals in the post-period were non-government-owned.

#### *Market Characteristics*

In both the pre- and post-periods and compared to non-merged rural hospitals, merged rural hospitals were closer to the nearest large hospital, more likely to be in the south, and in larger markets with higher unemployment rates. The only statistically significant unadjusted market difference-in-difference was that merging was associated with smaller post-merger markets. This finding suggests that merged rural hospital markets shrank more than non-merged rural hospital markets.

### **Adjusted Difference-in-Differences Effect of Merging on Rural Hospital Inpatient and Outpatient Charges, 2005-2015**

Difference-in-differences models were used to determine the relationship of key hospital factors with inpatient and outpatient charges by comparing pre/post-merged rural hospitals to pre/post otherwise similar non-merged rural hospitals. Results are presented in Table 3.2. After controlling for other characteristics and compared to otherwise similar non-merged rural hospitals, merged rural hospitals billed 17.73% more inpatient charges and 12.66% more outpatient charges at baseline. The adjusted difference-in-differences estimates revealed that, compared to similar non-merged rural hospitals over the same period, merging was associated

with a 3.04% decrease in inpatient charges. These results were statistically significant. The adjusted difference-in-differences between the same groups for outpatient charges showed that merging was associated with a 1.07% increase in outpatient charges ( $p=0.082$ ). While the outpatient finding was not statistically significant at  $p<0.05$ , it showed a statistical trend and may have been of clinical importance.

To contextualize the potential impact of changes in inpatient and outpatient charges on services, additional relationships were determined for total inpatient discharges, ADC, total revenue, and NPR as outcome measures. At baseline and compared to similar rural hospitals that did not merge, hospitals that merged at some point during the study period discharged more patients, reported a higher ADC, and generated more total and net patient revenue. After adjustments and compared to similar non-merged rural hospitals over the same time period, merging was associated with a 4.38% decrease in total revenue, a 3.58% decrease in NPR, and no change in discharges or ADC.

### **Discussion**

The difference-in-differences estimate for inpatient charges was statistically significant and clinically important; merging was associated with a sizeable 3% decrease in inpatient charges. A possible explanation for the post-merger decrease in inpatient charges could have been a decrease in the mix and/or complexity in inpatient services provided by rural hospitals in the post-merger period.<sup>iii</sup> However, the decrease in inpatient charges could be related to several other post-merger changes, such as patient volumes, prices, and/or payer mix. Our findings on total inpatient discharges, ADC, total revenue, and NPR added context to why inpatient charges may have decreased post-merger.

We found inpatient volumes, measured by total discharges and ADC, at rural hospitals that merged did not change due to a merger. Therefore, the decrease in inpatient charges were

likely not associated with post-merger changes in inpatient volumes, at least in the near-term. This finding was unexpected as prior research showed inpatient discharges decreased after a merger.<sup>16,17</sup> Inconsistencies in findings could be related to differences in the samples (e.g., our sample was exclusively rural hospitals, previous studies evaluated rural and non-rural hospitals without stratification) and/or sample periods (our sample was 2005 through 2016, previous studies evaluated mergers that occurred during or before 2000).<sup>16,17</sup> The post-merger decrease in charges with constant patient volumes could have been explained by a decrease in prices. However, prior research suggested merged hospitals increased, not decreased, prices as markets became less competitive.<sup>54,56-58</sup> We then considered if the post-merger decrease in revenue, measured by total revenue and NPR, was caused by a less favorable payer mix. If the proportion of uninsured or underinsured patients increased or commercially insured patients decreased post-merger, revenue could have fallen without an impact to charges. However, we did not suspect this to have been the case because charges also fell, and did so at roughly the same rate as revenue (3%).

Taken as a whole, a decrease in inpatient charges and revenue with no change in inpatient volumes could be associated with a post-merger decrease in service offerings and/or complexity of inpatient services at the rural hospital. However, the extent and significance of any service changes remains unclear. Future work could build upon these findings to determine whether acquirers are reducing or eliminating certain services at rural hospitals after a merger and how changes in service delivery could impact patients in those rural communities.

The difference-in-differences estimate for outpatient charges (+1%,  $p=0.082$ ) was not statistically significant at  $p<0.05$ ; however, this outcome exhibited a statistical trend that provided meaningful context to what was previously known about post-merger changes in rural

hospital outpatient services. Prior to our work, the only known study to have evaluated post-merger changes in rural hospital outpatient services found no post-merger change in outpatient revenue as a proportion of total revenue and concluded there was no indication that mergers led rural hospitals to shift towards outpatient care.<sup>59</sup> There were notable differences between studies, including differences in sample sizes and time periods, methodological approaches, and outcomes measured. The slight post-merger increase in outpatient charges left us questioning whether outpatient care changed at merged rural hospitals, particularly in light of decreasing inpatient charges.

### **Conclusion**

We found merging was strongly associated with a decrease in inpatient charges and somewhat associated with an increase in outpatient charges for rural hospitals. Merging was also associated with a decrease in total revenue and NPR but no change in total discharges or ADC. One potential explanation for decreases in inpatient charges and revenue with no change in inpatient volumes could be decreases in the mix and/or complexity in inpatient services provided after merger. Future work could build upon our findings to determine whether merging changed service delivery at rural hospitals, and ultimately what impact that may have on members of those communities.

### **Limitations**

Our study had limitations. First, key outcomes were measured in charges. Charges did not capture the type and extent of services provided. To account for differences across hospitals in charges and costs, we controlled for the cost-to-charge ratio and estimated models with total inpatient discharges, ADC, total revenue, and NPR as outcomes. Future work may benefit from our conclusion by evaluating a measure of service complexity, such as case-mix index. To

estimate the impact of rural mergers on outpatient services, researchers could measure outpatient visits as an outcome, as previous U.S. hospital merger research did.<sup>17</sup>

Second, this sample included only hospitals that met our definition of a merger. Failing to identify non-merged affiliations could have attenuated coefficients towards the null because hospitals involved in non-merged affiliations were considered non-merged in these analyses, though these hospitals may have experienced similar changes in outcomes to hospitals that merged. We accepted this limitation because the only known source that identified system affiliation was the American Hospital Association data, which was reported to “somewhat frequently” delay accurately reporting the correct system affiliation for merged hospitals.<sup>37</sup>

Third, as with any merger analysis, our sample was limited by left and right censoring (e.g., we did not know which hospitals merged before the sample period began in 2005 or after the sample period ended in 2016). We mitigated this concern because we sought to determine short-term merger impacts (e.g., in the year immediately following and prior to merger).

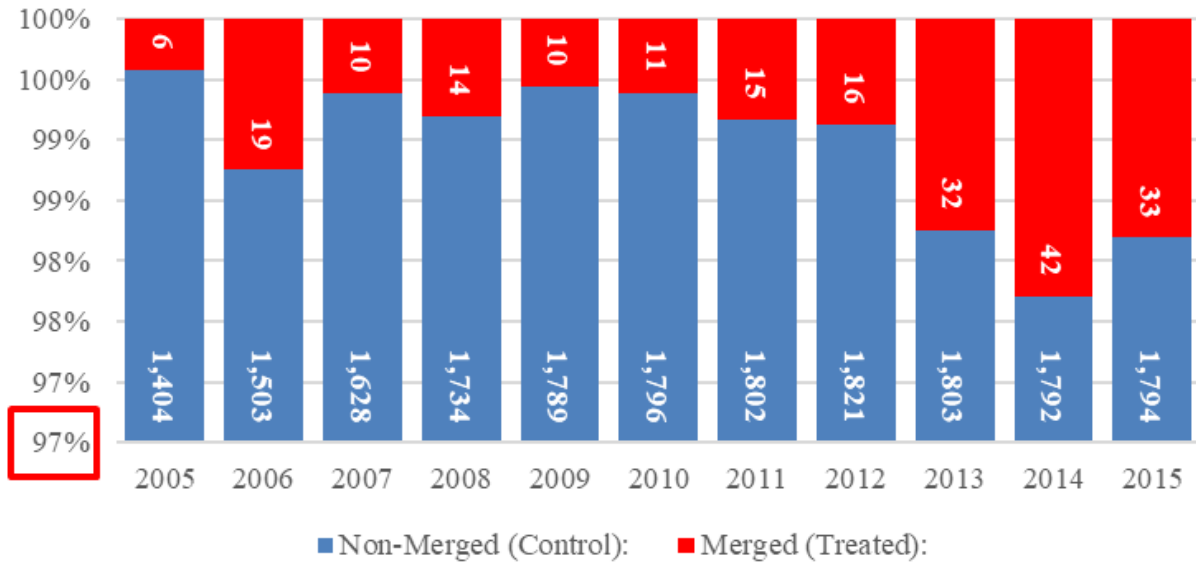
## ENDNOTES

<sup>i</sup> For this research, hospital mergers occurred when an acquiring entity (acquirer) took majority ownership of another hospital (target).

<sup>ii</sup> Effective merger dates occurred on the date majority ownership effectively changed hands.

<sup>iii</sup> Service mix was defined as the types of services provided, e.g., obstetrics, surgery, and/or inpatient medical. Service complexity was defined as the level of difficulty and resources involved in providing care. Lower service complexity may have been associated with lower billings (charges) and lower revenue.

**Figure 3.1: Annual Number of Rural Hospital-Years Included in Analysis**

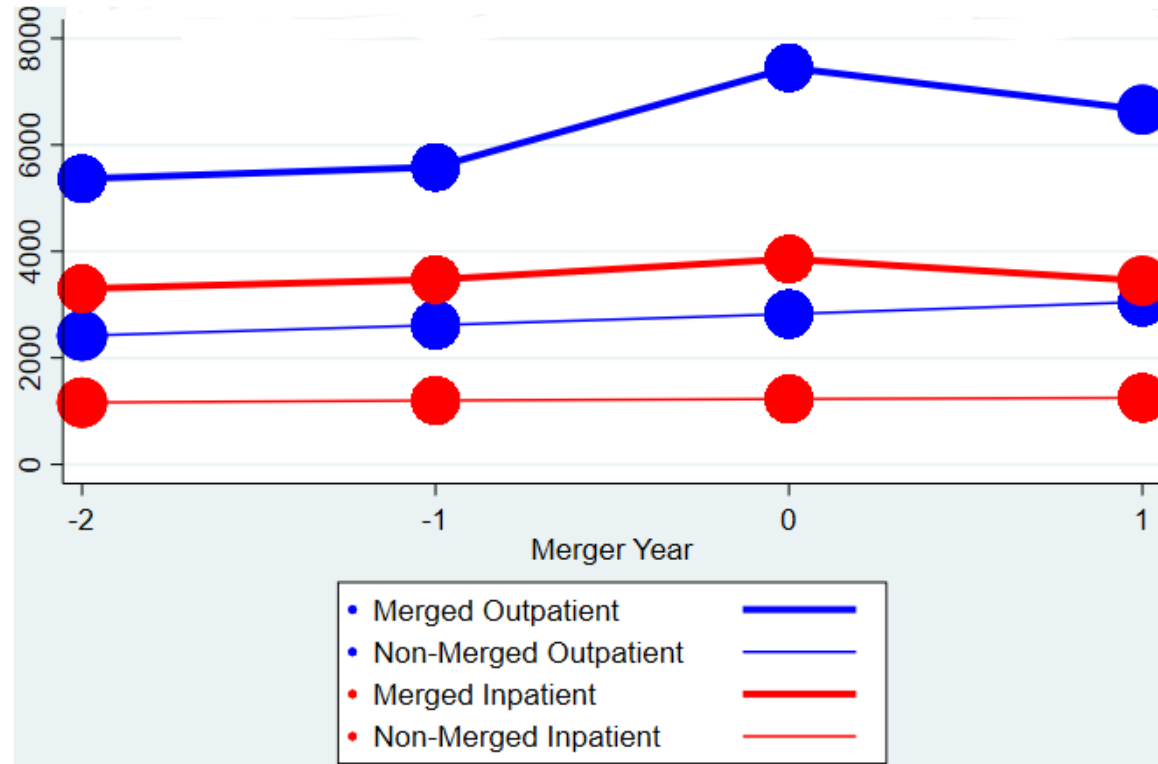




**Table 3.1: Characteristics of Merged and Non-Merged Rural Hospitals in the Year Prior to and After Merger**

Variable	Year Prior to Event		Year After Event		Difference in Post Minus Pre Event		Unadjusted Diff-in-diff	
	Non-Merged Hospitals (N= 18,866)	Merged Hospitals (N= 208)	Non-Merged Hospitals (N= 18,866)	Merged Hospitals (N= 208)	Non-Merged Hospitals (N= 18,866)	Merged Hospitals (N= 208)		P
<b>Outcomes</b>								
Inpatient Charges (\$10,000s)	\$ 1,237.67	\$ 3,673.91	\$ 1,283.52	\$ 3,485.96	\$ 45.85	\$ (187.95)	\$ (233.80)	<0.01**
Outpatient Charges (\$10,000s)	\$ 3,103.47	\$ 6,872.46	\$ 3,640.81	\$ 9,508.30	\$ 537.34	\$ 2,635.84	\$ 2,098.50	
<b>Control Variables</b>								
<b>Hospital Characteristics</b>								
<b>Ownership Status (%)</b>								
Not-for-Profit	54.32%	67.13%	54.43%	69.43%	0.11%	2.30%	2.19%	<0.001***
For-Profit	6.88%	19.23%	6.89%	21.02%	0.01%	1.79%	1.78%	
Government	38.80%	13.64%	38.69%	9.55%	-0.11%	-4.09%	-3.98%	
<b>CAH Status (%)</b>								
Non-CAH, PPS	47.56%	64.81%	-	-	-	-	-	
CAH	52.44%	35.19%	-	-	-	-	-	
<b>Hospital Provides Obstetrics (%)</b>								
Does Not Provide Obstetrics	47.16%	47.82%	-	-	-	-	-	
Provides Obstetrics	52.84%	52.18%	-	-	-	-	-	
Medicare CCR (%)	39.40%	29.66%	37.63%	28.37%	-1.77%	-1.29%	0.48%	
FTEs per Bed	5.61	4.79	5.58	4.56	-0.03	-0.23	-0.20	
<b>Market Characteristics</b>								
Distance to Nearest Large (>100 bed) Hospital (miles)	33.96	25.81	34.16	27.44	0.20	1.63	1.43	
Market Share (cases) Captured (%)	24.84%	24.18%	23.50%	23.49%	-1.34%	-0.69%	0.65%	
Market Total Population (millions)	3.21	6.02	3.18	5.50	-0.03	-0.52	-0.49	
Market Unemployment Rate (%)	7.52%	8.22%	7.91%	8.58%	0.39%	0.36%	-0.03%	
<b>Region (%)</b>								
South	34.40%	42.77%	-	-	-	-	-	
Midwest	39.65%	41.90%	-	-	-	-	-	
Northeast	6.99%	11.87%	-	-	-	-	-	
West	18.96%	3.47%	-	-	-	-	-	
Medians for continuous variables, means for non-continuous variables.								
P-values by t-test for continuous variables and chi2 test for binary / categorical variables								
* p<0.05, ** p<0.01, *** p<0.001								
Missing values: CCR (49 obs) FTEs per Bed (134 obs) Size (33 obs) Distance (59 obs) Market Share (59 obs) Population (59 obs) Unemployment Rate (59 obs)								

Figure 3.2: Unadjusted Annual Average Charges by Service and Merger Status



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**Table 3.2: Adjusted Difference-in-Differences Effect of Merging on Rural Hospital Inpatient and Outpatient Charges, 2005 – 2015**

Outcome	Estimates
Inpatient Charges (Natural Log)	
Year After Event (Ref: Year Prior to Event)	0.11%
Merging	17.73%***
Adjusted difference-in-differences	-3.04%***
Outpatient Charges (Natural Log)	
Year After Event (Ref: Year Prior to Event)	-0.48%
Merging	12.66%***
Adjusted difference-in-differences	1.07% <sup>+</sup>
Total Discharges (Natural Log)	
Year After Event (Ref: Year Prior to Event)	-0.34%
Merging	7.30%***
Adjusted difference-in-differences	-0.70%
Acute Daily Census	
Year After Event (Ref: Year Prior to Event)	0.42*
Merging	1.20*
Adjusted difference-in-differences	-0.58
Total Revenue (Revenue, Natural Log)	
Year After Event (Ref: Year Prior to Event)	0.59%
Merging	4.35%***
Adjusted difference-in-differences	-4.38%***
Net Patient Revenue (Revenue, Natural Log)	
Year After Event (Ref: Year Prior to Event)	0.55%
Merging	5.73%***
Adjusted difference-in-differences	-3.58%**
+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001	

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## **CHAPTER 4. STUDY 3 PAPER: CAPITAL EXPENDITURES INCREASED AT RURAL HOSPITALS THAT MERGED BETWEEN 2012 AND 2015**

### **Overview**

#### **Objective**

To determine whether total capital expenditures changed at rural hospitals after a merger.

#### **Data Sources**

Hospital merger status was derived from proprietary Irving Levin Associates data and hospital-level characteristics were derived from HCRIS, CMS Impact File Hospital Inpatient Prospective Payment System, Hospital MSA file, AHRF, and U.S. Census data.

#### **Study Design**

A difference-in-differences approach was used to determine whether total capital expenditures changed at rural hospitals after a merger. The comparison group (rural hospitals that did not merge at any point during the sample period) was weighted using inverse probability of treatment weights. The key outcome measure was logged total capital expenditures. To contextualize changes in capital expenditures, five additional outcomes were evaluated: total capital expenditures as a proportion of total revenue, total revenue, net patient revenue (NPR), total inpatient discharges, and acute bed average daily census (ADC).

#### **Principal Findings**

1. The difference-in-differences estimate showed that merging was associated with a 26.4% increase in total capital expenditures, which was statistically significant ( $p < 0.001$ ).
2. Merging was not associated with a change in the ratio of capital expenditures to total expenditures.

3. Merging was associated with a significant improvement in plant age.

### **Conclusions**

Merging was strongly associated with higher capital expenditures at merged rural hospitals. The increase in capital expenditures at merged rural hospitals was not entirely attributable to differences in hospital size. The post-merger improvement in plant age may have been partially attributable to merger-related accounting changes and partially attributable to increased capital expenses, possibly on long-term asset renovations and replacement.

### **Implications**

These findings suggest that through mergers, rural hospital board members and executives who have accepted or are considering a merger may improve a hospital's ability to increase capital expenditures. Further, increased capital investments into rural hospitals may be an important signal to the community that the acquirer intends to keep the rural hospital open and continue providing some volume and level of services within the community. Future work should determine how capital is spent after a merger.

### **Introduction**

Growing financial pressures and sweeping policy changes<sup>1-5</sup> have accelerated the need for U.S. hospitals to streamline resources, improve facilities, and invest in better technology to provide high quality health care to their patients.<sup>6</sup> Rural hospitals often do not have the resources (e.g., capital) necessary to meet these demands.<sup>7,8</sup> Compared to non-rural hospitals, rural hospitals generally report smaller profit margins<sup>9</sup> and weaker balance sheets.<sup>10</sup> These factors can lead to higher borrowing rates and, at times, an inability to fund debt externally. Rural hospitals, compared to their non-rural counterparts, also operate older facilities<sup>11</sup> and are slower to adopt capital-intensive technology like electronic health records (EHRs) that is required for enhanced CMS reimbursement.<sup>7,8</sup> For example, part of the 2009 HITECH Act tied reimbursement and

penalties to the meaningful adoption (Meaningful Use or “MU”) of EHRs.<sup>8,10</sup> However, to pay for new technology like EHRs, hospitals require strong access to capital.

Several potential sources of capital exist for rural hospitals to maintain or expand access to health care services. For purposes of this research, a summary of funding sources by hospital ownership type is provided in Table 4.1. The left column shows conventional capital sources used by rural hospitals. The Rural Health Information Hub presents extensive information on conventional rural hospital capital funding opportunities.<sup>12</sup> The center column shows there are alternative capital sources which have been used by rural hospitals otherwise unable to fund capital projects through more conventional sources. The right column shows there are consequences for rural hospitals that are unable to access capital. For rural hospitals unable to access capital through more conventional sources, a merger may be an opportunity to improve access to capital.<sup>6</sup> Rural hospital merger activity has increased in recent years. Between 2011 and 2016, a total of 261 rural hospitals merged – more than twice the number of mergers observed for this type of hospital over the preceding six-year period.<sup>13</sup>

Increasing post-merger capital investments at merged rural hospitals may be a common pre-merger promise made by acquirers. Two 2017 industry surveys reported post-merger improvements regarding access to capital and capital expenditures at merged U.S. (not specifically rural) hospitals.<sup>6,14</sup> In the Deloitte and HFMA survey, hospital executives reported “increased access to capital” as the number one reason their hospitals chose to merge, with nearly 80% of respondents confirming “significant capital investments were made in the acquired facility” post-merger.<sup>6</sup> Those executives reported new capital expenditures for Healthcare Information Technology (HIT) (37%), acute facility upgrades (33%), physician practice acquisitions (30%), ambulatory care facilities (27%), administrative information systems

(24%), and new movable medical equipment (17%).<sup>6</sup> The Charles River survey reported increased access to capital, better credit ratings, and reduced capital demands across sites after a merger.<sup>14</sup> While the reports of increased access to capital are consistent across surveys, we could not identify any empirical evidence that supports those claims for rural hospitals.

The objective of this research is to determine whether capital expenditures changed at rural hospitals after a merger. We hypothesize acquirers' increase post-merger capital expenditures at rural target hospitals. Reasons for increased capital expenditures may be to replace aging facilities, grow services, and meet the demands of changing reimbursement policies, regulations, technology, and patient preferences.<sup>15</sup> For acquirers wanting to increase capacity, it is often cheaper to upgrade facilities at an under-utilized target hospital than to build a new physical plant at the acquirer's site.<sup>14</sup> Acquirers may invest capital in rural targets to increase outpatient services, which can then be used to generate downstream referrals for more complex services offered at the acquirer.<sup>16</sup> In those situations, acquirers may find it necessary to merge to avoid Stark and anti-kickback violations related to investing capital into a separate, non-owned entity.<sup>14</sup> Increasing capital expenditures at merged rural hospitals could be a positive signal to the rural community that the acquirer intends to keep the rural hospital open and continue providing some volume and level of services within the community. This positive signal may in turn result in increased investments in other areas of the community and a general improvement in local economic conditions that then improve the viability of the rural hospital.

It is important that we determine whether and to what extent post-merger capital improves for rural hospitals. Our results will provide rural decision-makers with evidence on the likelihood of observing an increase in capital expenditures at rural hospitals due to mergers and of the magnitude they might expect. Decision-makers can use this information in two ways: 1) to

inform negotiations about capital investments prior to mergers; and 2) to plan for the use of capital to enhance their ability to meet the demands of patient preferences (e.g., newer facilities and the latest medical technology) and reimbursement policies (e.g., meaningful electronic health record adoption).<sup>10</sup>

## **Methods**

### **Data Sources**

We combined multiple secondary data sources to form a panel for years 2003-2016. Hospital-level characteristics were combined from HCRIS “cost report” data, the CMS Impact File Hospital Inpatient Prospective Payment System, the Hospital MSA file, the AHRF, and U.S. Census data. Data from hospital-reported cost report fiscal years (HFYs) was combined with a hospital’s merger status. A hospital’s merger status was derived from proprietary data found in the “The Health Care Services Acquisition Report” by Irving Levin Associates for 2005–2016.

### **Study Design**

We estimate a difference-in-differences model for total capital expenditures. The difference-in-differences estimator compares pre/post merged rural hospitals to pre/post non-merged rural hospitals. The difference-in-differences model controlled for unobservable differences between rural hospitals that merged and those that did not merge that are expected to remain stable over time. One example of an unobservable difference could be a need for hospital services within the community.

To determine whether and when a rural hospital merged, we began with the Levin data. We verified whether and when “announced” mergers occurred by creating an “effective” date through searching publicly-available documents online (e.g., for-profit IRS Form 10-Ks, not-for-profit IRS Form 990s, and annual reports from hospital websites) and, when necessary, calling and emailing leaders of rural hospitals. This process is further described in other work by the

authors.<sup>13</sup> Rurality was defined according to the criteria specified by the Federal Office of Rural Health Policy, and other federal programs.<sup>17</sup>

Because we analyze data by discrete years, not specific dates within a year, it was necessary to align effective<sup>ii</sup> merger dates with the correct HFY. Doing so was essential to compare hospital data from the correct time period because the HFY differed from the calendar year of the effective date approximately two-thirds of the time.<sup>11</sup>

We excluded partial-year data reported for less than 360 days<sup>18</sup> and data that did not include positive values for the outcome measure. We limited our analysis to the first merger during the study period. Control hospitals were rural hospitals that did not merge during the sample period (2005-2016). Non-merged controls were included as many times as there was complete data.

#### *Weighting Non-Merged Rural Hospitals*

Inverse probability of treatment weights (IPTWs) were applied to addresses suspected selection bias around which rural hospitals merged. Weights created a pseudo-population under which the group of merged rural hospitals more closely resembled the group of non-merged control hospitals. Weights were based on the same independent variables specified in the subsequent “Control Variables” section, a process often described as “doubly-robust.”<sup>19</sup> Doubly-robust estimation has been described as a preferred measure to address selection bias because it provides two opportunities to address model misspecification based on observable characteristics.<sup>19</sup> After applying IPTWs, baseline variables were balanced across comparison groups such that standardized differences were <10%.

One potential concern in our analysis was that hospitals reporting years of unusually weak financials may merge. Such an occurrence may have led to an overestimate of the “effect” of merging due simply to regression to the mean, sometimes referred to as an Ashenfelter

Dip.<sup>20,21</sup> In this case, rural hospitals may have merged in response to recent outcomes, such as low patient volumes, unsustainable fixed costs, and poor revenue in the year immediately prior to a merger. Therefore, we weighted based on data from two years prior to merger.

### *Analytical Years*

To be included in this analysis, hospitals must have reported three years of full-year cost report data: the year prior to merger, the year following merger (to compare pre/post differences), and two years prior to merger (to weight controls). The year of merger (transition year) was excluded from analyses. We compared merger activity in the year immediately prior to merger (pre-merger) and the year immediately after merger (post-period).

In Figure 4.1, we show the process for which and when data was used for a rural Oklahoma hospital that merged in 2012. Full-year cost report data for that hospital and its weighted controls was required for HFYs 2010, 2011, and 2013 (Figure 4.1, blue years). To model the pre/post difference in rural hospitals that merged, data was necessary for HFYs 2011 and 2013. To weight similar control hospitals, data was also required for HFY 2010. Because hospitals were limited to the first merger during the sample period, any subsequent mergers of the Oklahoma hospital were excluded (Figure 4.1, bottom left image). However, non-merged controls could have been included in the comparison group as many as four times, with four different weights that aligned with the comparison merged hospitals' FYs (Figure 4.1, bottom right image).

We cleaned data for completeness using complete case analysis (CCA) and addressed extreme values by Winsorizing<sup>22</sup> (censoring) those values at the one percent tails of each variable's distribution.<sup>23</sup> Descriptive statistics were weighted by two factors: 1) the annual proportion of merged hospitals relative to all mergers and 2) days in period (DIP). For example, 15 of the 121 merged hospital-years occurred in 2012. Therefore, descriptive statistics for merged and non-

merged hospital-years for 2012 were weighted as a 15/121<sup>st</sup> proportion of the overall means/medians. Statistics were then weighted at the hospital year-level for DIPs. Differences between groups were tested using Pearson's chi-square (categorical variables) and Wilcoxon rank test of medians (continuous variables) using 0.05 as the probability of Type 1 error.

## **Study Sample**

The final sample was limited to rural hospitals that met the inclusion criteria described in the previous section for 2012 through 2015. In 2010, CMS implemented a new cost report form. The 2010 cost report form made several significant changes from the previous 1996 form. One of those changes was the addition of new data elements for capital expenditures. Because the majority of rural hospitals in our sample did not consistently report capital expenditures prior to the introduction of the 2010 form, it was necessary to begin our analysis with data from the newer 2010 cost report forms. Since we weighted hospitals using data from two years prior to a merger, the earliest available weighting data was 2010 for 2012 mergers. In our sample there were 165 unique rural hospitals that merged between 2012 and 2015, though only 121 reported the data necessary for us to conduct our analyses.

The final sample consisted of 14,016 observations, 242 of which were associated with a merger and 13,774 of which are not. Because of the pre/post comparison, the final sample consisted of 121 merged hospital-years ( $242/2=121$ ) and 6,887 non-merged hospital-years ( $13,774/2$ ) (Figure 4.2).

## **Study Variables**

### *Dependent Variable*

We derived total capital expenditures from cost report form A-7, column 6 minus column 1, row 10. We logged the outcome because of skewed distributions.



### *Additional Dependent Variables*

To contextualize changes in capital expenditures, we estimated five additional models on total capital expenditures as a proportion of total revenue (capex/total revenue), total revenue, net patient revenue (NPR), total inpatient discharges, and acute bed average daily census (ADC). Total revenue, NPR, and total inpatient discharges were logged because of skewed distributions. Total revenue was derived from worksheet G-3, column 1, lines 3+25. NPR was derived from worksheet G-3, column 1, line 3. Total inpatient discharges was derived from cost report worksheet S-3, part 1, column 15, line 1. ADC was derived from cost report worksheet S-3, column 8, lines (14-5-6-13)/DIP. Capex/total revenue was derived as the quotient of capital expenditures and total revenue.

### *Key Independent Variables*

The difference-in-differences parameter estimate determined the difference in hospital capital expenditures attributed to merging between merged and weighted non-merged rural hospitals (difference 1) and between pre-merged and post-merged periods (difference 2).

### *Control Variables*

Hospital characteristics included ownership,<sup>24,25,26</sup> CAH status,<sup>27</sup> whether a hospital provided obstetrics services, outpatient cost to charge ratio (CCR),<sup>28</sup> FTEs per bed,<sup>29</sup> average plant age, and the ability to cover debt. Ownership – categorized as private for-profit, private not-for-profit, and government-owned – controlled for differing financial objectives.<sup>30-33</sup> CAH status controlled for Medicare cost-based reimbursement.<sup>27</sup> Whether a rural hospital provided obstetric services controlled for service mix differences. Fewer rural hospitals provide obstetrics, with over 7% of all rural hospitals closing their obstetric units between 2004 and 2014.<sup>34-36</sup> Providing obstetrics may indicate broader associations with other services provided by rural hospitals. A hospital was considered to have obstetrics if at any point during the sample period

(2003 – 2016), the hospital 1) reported offering obstetric services in OSCAR data and 2) reported obstetric charges >\$10,000 in at least one cost report. Medicare outpatient CCR controlled for potential differences in billing and/or cost inefficiencies.<sup>37</sup> FTEs per bed<sup>37</sup> controlled for potential differences in patient volumes and/or staff productivity. Average plant age, measured as quartiles for all merged and non-merged rural hospitals in each analytical year, controlled for the age of fixed assets.<sup>37</sup> To control for a hospital's ability to pay existing debt, we created a variable called "ability to cover debt payments" using debt service coverage ratios (DSCRs).<sup>37</sup> We categorized non-missing DSCRs  $\geq 1$  as able to cover current debt and non-missing DSCRs  $< 1$  as unable to cover current debt.

Market characteristics included distance to the nearest large (e.g., >100 bed) hospital, market share captured, total population,<sup>23</sup> unemployment rate,<sup>38,39</sup> and region.<sup>40</sup> Hospital market areas are created using Medicare discharge counts by ZIP code from the CMS Hospital Service Area File. A ZIP code is included in the market if, when sorted in descending number of that hospital's Medicare discharges, it is among the ZIPs that comprise the first seventy-five percent of that hospital's Medicare discharges<sup>41</sup> or if it contributes at least three percent of that hospital's Medicare admissions for the year. Except for hospitals in Alaska and Hawaii, ZIP codes more than 150 miles from the hospital are disqualified from being in its market. The market areas are not specified to be mutually exclusive, exhaustive, or contiguous. Low-population or low Medicare population ZIP code areas in otherwise dense areas are more likely to be excluded from a market based on this definition.

Distance to the nearest large (e.g., >100 bed) hospital (logged miles), controlled for proximity to other hospitals. Proximity has been associated with acquirers' abilities to implement changes at targets due to distance.<sup>42-44</sup> While the nearest large hospital was not always the

acquirer, this research was limited by not knowing the acquirer. Therefore, distance was measured to the nearest large hospital. Market share captured, measured as the proportion in inpatient discharges captured within a hospital's market, controlled for market competition. Population (logged) controlled for market size.<sup>27</sup> Unemployment rate controlled for local economic conditions.<sup>27</sup> Region controlled for potential unobserved geographic differences. Year fixed effects control for unobserved correlation of year-specific effects. DIP controlled for differences due to the number of days in the data reporting period.

## Results

### **Descriptive Statistics of Rural Hospitals by Merger Status, Pre/Post-Merger (2011-2016)**

In Table 4.2, we present descriptive statistics of rural hospitals by merger status and time. The first two columns depict rural hospital-year averages in the pre-merger period by merger status. The third and fourth columns display the same information by merger status but for the post-merger period. The fifth and sixth columns represent differences in the post- and pre-merger periods by merger status. The far-right columns present the unadjusted difference in time periods and merger status (unadjusted difference-in-differences).

#### *Total Capital Expenditures*

In both the pre- and post-periods and compared to non-merged rural hospitals, rural hospitals that merged at some point during the study period spent substantially more on capital. Notably, merged rural hospitals increased capital expenditures post-merger while non-merged rural hospitals marginally decreased capital expenditures. The unadjusted difference-in-differences for capital expenditures was non-trivial; merging was associated with an unadjusted increase in the median capital expenditures of \$614,500. Differences in capital expenditures are

depicted visually in Figure 4.3A across a four-year period. The vertical red line in that figure denotes the year in which a merger occurred.

### *Hospital Characteristics*

In both the pre- and post-periods and compared to non-merged rural hospitals, merged rural hospitals were more likely to be non-government owned, non-CAH PPS hospitals with a lower cost-to-charge ratio and fewer FTEs per bed. Two important factors changed across time periods for merged rural hospitals compared to non-merged rural hospitals: the ability to cover debt and average plant age. Among rural hospitals that reported DSCR, merging was associated with an unadjusted increase in a rural hospital's ability to cover debt.

Pre-merger and compared to all (merged and non-merged) rural hospitals, only 13.3% of merged rural hospitals reported plant age that fell within the newest quartile. Post-merger, that proportion increased to 65.9% - an incredible 52.6 percentage point increase. Unadjusted, merging was associated with a 55.5% higher likelihood of reporting plant age that was among the newest quartile. Because of the sizeable unadjusted change in plant age, we quantified that change annually in Figure 4.3B, which shows plant age began to drop during the merge year but fell in the year after a merger. Then, in Figures 4.3C and 4.3D, we explored the components of plant age. Plant age was calculated as accumulated depreciation divided by (depreciation expense times 365 divided by DIP). Figure 4.3C shows accumulated depreciation noticeably fell in both the year of and the year after merger. Figure 4.3D shows depreciation expense actually fell in the year of merger but then increased in the year after a merger.

### *Market Characteristics*

In both the pre- and post-periods and compared to non-merged rural hospitals, merged rural hospitals were closer to the nearest large hospital, less likely to be in the west, and in larger markets with slightly higher unemployment rates.

## **Adjusted Difference-in-Differences Effect of Merging on Total Capital Expenditures by Rural Hospitals, 2012-2015**

Difference-in-differences models were used to determine the relationship of key hospital factors with total capital expenditures by comparing pre/post-merged rural hospitals to pre/post otherwise similar non-merged rural hospitals. Results are presented in Table 4.3. The adjusted difference-in-differences estimate revealed that, compared to similar non-merged rural hospitals over the same time period, merging was associated with 26.4% higher post-merger capital expenditures. This result was statistically significant ( $p < 0.001$ ). The adjusted difference-in-difference estimate for plant age showed merging was associated with a statistically significant 39.8% higher post-merger likelihood to report plant age among the newest, relative to the oldest, quartile (unreported).

To contextualize adjusted difference-in-differences in capital expenditures, additional relationships were determined for the ratio of capital expenditures to total revenue (capex/total revenue), total revenue, NPR, total inpatient discharges, and acute bed average daily census (ADC) as outcome measures. At baseline and compared to similar rural hospitals that did not merge, hospitals that merged at some point during the study period were larger by all four measures (total revenue, NPR, total inpatient discharges, and ADC) but did not spend significantly different proportions of total revenue on capital. After adjustments, merging was associated with a decrease in total revenue, an increase in total inpatient discharges, but no change in capex/total revenue, NPR, or ADC. Merging was associated with significant increases in capital expenditures and significant decreases in total revenue but not associated with a change in the ratio of those two outcomes. That difference occurred because of differences in scales (e.g., revenue and expenses were estimated in logged dollars, the ratio was estimated as a fraction). Also noteworthy, four of the sensitivity measures (total revenue, NPR, total inpatient

discharges, and ADC) were estimated in previous work by the authors that, to date, has not yet been published. However, that work evaluated a different population of merged rural hospitals, which explains differences in estimates for the same outcome between studies.

### **Discussion**

Merging was strongly associated with an increase in capital expenditures. The difference-in-differences analysis was statistically and clinically significant; merging was associated with 26.4% higher post-merger capital expenditures.

Capital expenditures did not simply increase because merged rural hospitals were relatively larger than non-merged rural hospitals. Though merged rural hospitals were larger at baseline than similar non-merged rural hospitals by all four size measures (total revenue, NPR, total inpatient discharges, and ADC), the adjusted difference-in-differences estimates suggested these measures of size did not materially change due to merging. Further, the ratio of capex/total revenue did not materially change due to merging.

Average plant age improved across periods for merged rural hospitals, relative to non-merged rural hospitals. Because plant age improved significantly in the relatively short pre/post-merger analytical period (e.g., one-year pre- to one-year post-merger), we explored the derivatives of plant age (Figures 4.3C and 4.3D) to assess whether plant age improved due to changes in accounting practices, investments in new facilities, or both. We found some support the improvement in plant age was likely attributable to changes in accounting practices. Under purchase accounting generally accepted accounting principles (GAAP), acquirers value target assets at fair value.<sup>45,46</sup> Balance sheet write-offs could occur if there were differences between the asset's historical carrying value and the fair value or if the acquirer's capitalization threshold was higher than the target's.<sup>47</sup> The post-merger drop in accumulated depreciation (Figure 4.3C) could have been consistent with significant write-offs. The impact on accumulated depreciation

may have been particularly large for a merging rural hospital if the hospital was not consistently performing periodic impairment assessment of long-lived assets in the pre-merger period.<sup>48</sup> If properly conducted, periodic impairment assessment could have partially mitigated large one-time write-offs after a merger.<sup>49</sup> But, doing so requires significant time, experience, and resources which some resource-constrained rural hospitals may not have been able to commit.<sup>49</sup> Even though a large amount of the change in plant age was due to accumulated depreciation, depreciation expense also impacted plant age. Figure 4.3D shows post-merger depreciation expense decreased in the year of merger before increasing post-merger. The dip in depreciation expense during the year of a merger may have indicated acquirers did not immediately invest in new depreciable assets at a rural target. However, the post-merger increase could have indicated there was an uptick in depreciable assets at merged rural hospitals in the year after a merger. In sum, the post-merger reduction of accumulated depreciation and increase in depreciation expense might suggest that post-merger, plant age decreased in part due to changes in accounting practices and in part due to an increase in capital investments into existing facility renovations or expansions.

### **Implications**

Compared to non-rural hospitals, rural hospitals generally operate older facilities<sup>11</sup> and are slower to adopt capital-intensive technology like EHRs that is required for enhanced CMS reimbursement.<sup>7,8</sup> Many of the rural hospitals built with federal capital funding provided through the 1946 Hill-Burton Act are not able to invest capital into renovations and replacements. Perhaps now more than ever, rural hospitals must spend more capital to meet the demands of patient preferences (e.g., newer facilities and the latest medical technology) and reimbursement policies (e.g., meaningful electronic health record adoption).<sup>10</sup>

Our findings contribute to the literature in at least three meaningful ways. One, through mergers, we found rural hospitals could access more capital. To our knowledge, this finding had not previously been empirically determined for rural or non-rural hospitals. Under a variety of scenarios, this finding is statistically significant at  $p < 0.05$ . Our findings also corroborate a common narrative offered by hospital executives that merging can increase access to capital.<sup>6,14</sup> For rural hospital leaders considering a merger, our findings provide support that a merger can improve capital expenditures. Two, increased capital expenditures at merged rural target hospitals could be an important signal to the community that the acquirer intends to keep the rural hospital open and continue providing some volume and level of services within the community. Three, our findings are foundational for future work to determine how capital may be allocated at rural target hospitals post-merger (e.g., facility enhancements, HIT, etc.).<sup>iii</sup>

## **Conclusion**

We found merging resulted in a 26% increase in capital expenditures at merged rural hospitals. The increase in capital expenditures at merged rural hospitals was not entirely attributable to hospital size differences. Merging was also associated with significant improvements in plant age. The post-merger improvement in plant age may have been partially attributable to merger-related accounting changes and partially attributable to an increase in capital expenses, possibly on long-term asset renovations and replacement. For rural hospital board members and executives, findings may suggest merging can improve capital expenditures. Future research should determine how post-merger capital infusions are allocated at merged rural hospitals.



## Limitations

Our study had limitations. This sample included only hospitals that met our definition of a merger. Failing to identify non-merged affiliations could have attenuated coefficients towards the null because hospitals involved in non-merged affiliations were considered non-merged in these analyses, though these hospitals may have experienced similar changes in outcomes to hospitals that merged. We accepted this limitation because the only known source that identified system affiliation was the American Hospital Association data, which was reported to “somewhat frequently” delay accurately reporting the correct system affiliation for merged hospitals.<sup>23</sup>

As with any merger analysis, our sample was limited by left and right censoring (e.g., we did not know which hospitals merged before the sample period began in 2005 or after the sample period ended in 2016). We mitigated this concern because we sought to determine short-term merger impacts (e.g., in the year immediately following and prior to merger).

## ENDNOTES

<sup>i</sup> For this research, hospital mergers occurred when an acquiring entity (acquirer) took majority ownership of another hospital (target).

<sup>ii</sup> Effective merger dates occurred on the date majority ownership effectively changed hands.

<sup>iii</sup> In sensitivity analyses, we initiated this research by evaluating four subcategories of capital expenditures from cost report form A7 (land and land improvements; building, fixtures, and building improvements; fixed and movable equipment; and HIT assets). We were limited by missing data and sample size limitations.

**Table 4.1: Sources for Rural Hospital Access to Capital**

Common Sources for Rural Hospitals to Access Capital	Alternative Sources for Rural Hospitals to Access Capital	Consequences of Not Being Able to Access Capital
<u>Not-for-Profits / Government-Owned</u>		
Loans (USDA Rural Development)	Impose an increase in the municipal sales tax	Operate aging facilities with older technology
Loan guarantees (Small Business Administration, U.S. Department of Housing and Urban Development Section 242 Mortgage Insurance Program, USDA Rural Development)	Sell hospital-controlled property or other property controlled by the municipal operator of the hospital	Close
Municipal bonds (State Health Facilities Finance Authorities)	Merge	
Public grants (ACF, EDA, USDA Rural Development)		
Private grants (foundations)		
Various grants for EHR or telehealth implementation		
Community Development Financial Institutions (CDFI) (U.S. Department of the Treasury CDFI Fund)		
<u>For-Profits</u>		
Debt capital (corporate bonds, bank loans, notes payable)	Merge	Operate aging facilities with older technology
Equity capital (stock)		Close
Loan guarantees (U.S. Department of Housing and Urban Development Section 242 Mortgage Insurance Program)		
Community Development Financial Institutions (CDFI) (U.S. Department of the Treasury CDFI Fund)		

**Figure 4.1: Inclusion Criteria for Merged and Weighted Non-Merged Rural Hospitals**

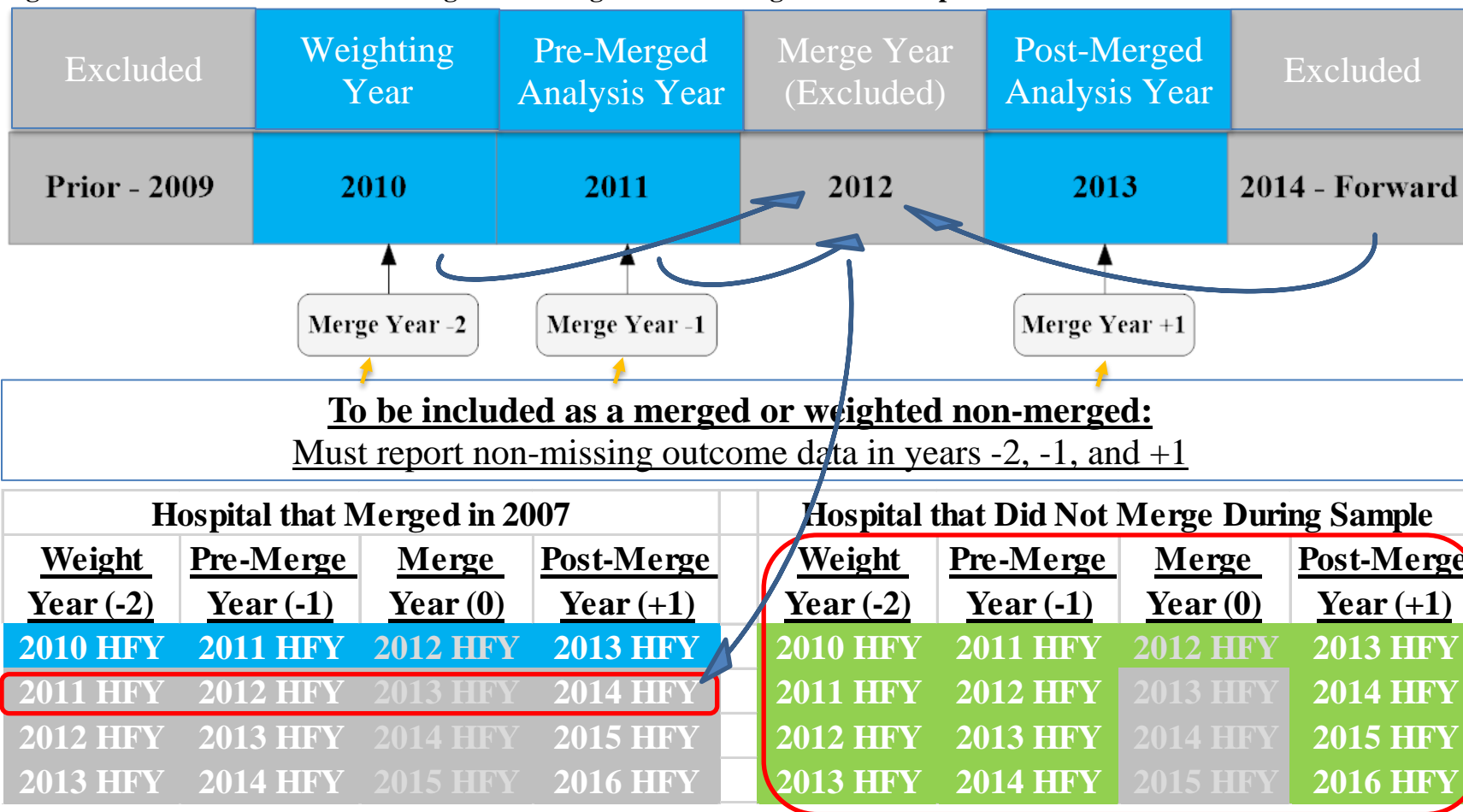
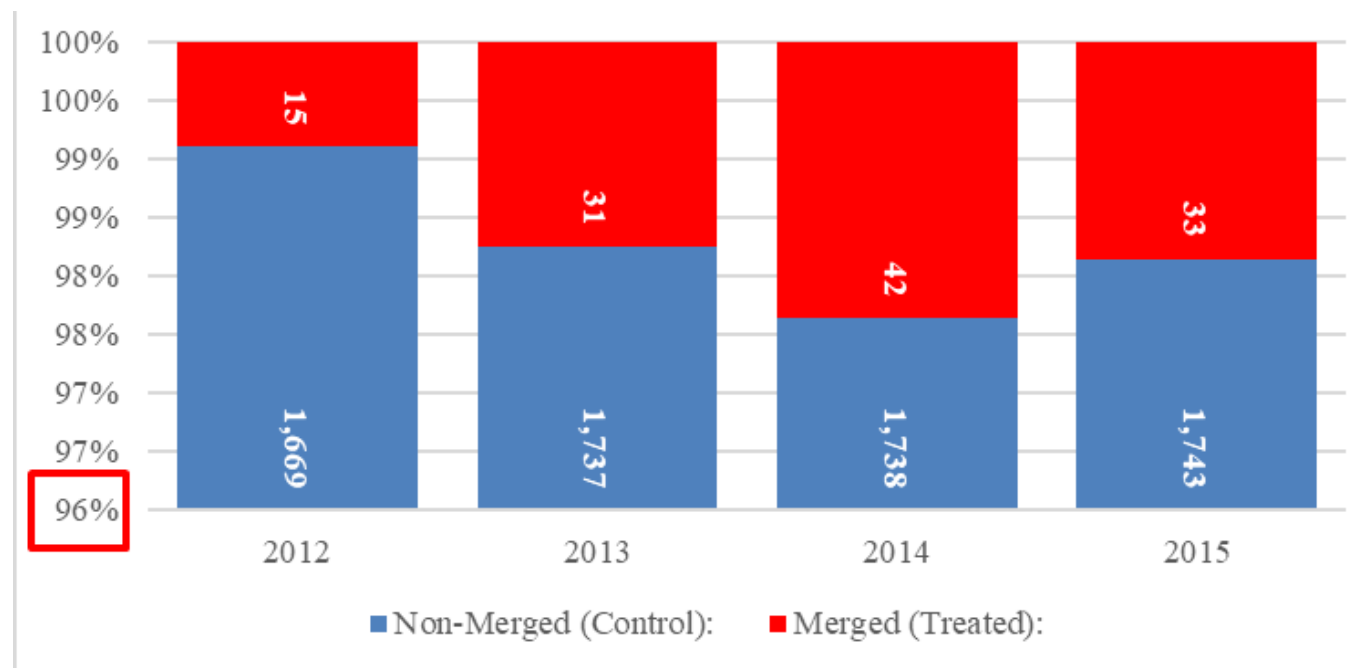


Figure 4.2: Annual Number of Rural Hospitals Included in Analysis

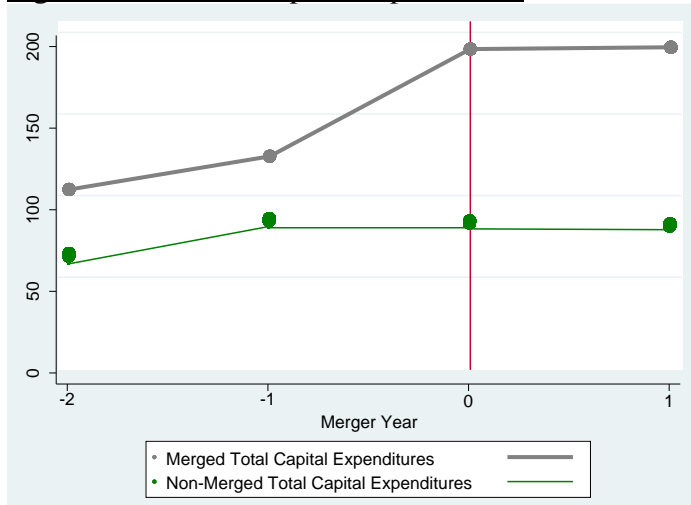


**Table 4.2: Characteristics of Merged and Non-Merged Rural Hospitals in the Year Prior to and After Merger**

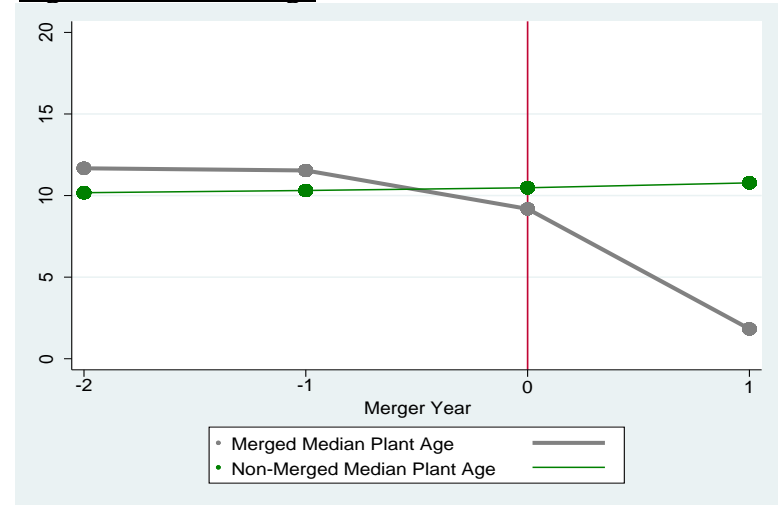
Variable	Year Prior to Event		Year After Event		Difference In Post Minus Pre Event		Unadjusted Diff-in-diff
	Non-Merged Hospitals (N=6,887)	Merged Hospitals (N= 121)	Non-Merged Hospitals (N=6,887)	Merged Hospitals (N= 121)	Non-Merged Hospitals (N=6,887)	Merged Hospitals (N= 121)	
<b>Outcome</b>							
Total Capital Expenditures (\$10,000s)	\$ 90.67	\$ 124.15	\$ 82.91	\$ 177.84	\$ (7.76)	\$ 53.69	\$ 61.45
<b>Control Variables</b>							
<i>Hospital Characteristics</i>							
<b>Ownership Status (%)</b>							
Not-for-Profit	55.40%	68.27%	55.47%	70.39%	0.07%	2.12%	2.05%
For-Profit	7.14%	18.84%	7.12%	19.36%	-0.02%	0.52%	0.54%
Government	37.46%	12.89%	37.41%	10.25%	-0.05%	-2.64%	-2.59%
<b>CAH Status (%)</b>							
Non-CAH, PPS	46.56%	64.37%	-	-	-	-	-
CAH	53.44%	35.63%	-	-	-	-	-
<b>Hospital Provides Obstetrics (%)</b>							
Does Not Provide Obstetrics	46.46%	47.91%	-	-	-	-	-
Provides Obstetrics	53.54%	52.09%	-	-	-	-	-
Medicare CCR (%)	38.66%	29.66%	36.98%	28.38%	-1.68%	-1.28%	0.40%
FTEs per Bed	5.70	4.79	5.62	4.63	-0.08	-0.16	-0.08
<b>Average Plant Age (% , quartiles)</b>							
Percent in Newest Quartile	21.45%	13.29%	18.53%	65.85%	-2.92%	52.56%	55.48%
Percent in Second Newest Quartile	26.36%	21.76%	24.33%	6.94%	-2.03%	-14.82%	-12.79%
Percent in Second Oldest Quartile	26.18%	31.34%	28.24%	14.00%	2.06%	-17.34%	-19.40%
Percent in Oldest Quartile	26.01%	33.61%	28.90%	13.22%	2.89%	-20.39%	-23.28%
<b>Ability to Cover Current Debt (%)</b>							
Unable to Cover Current Debt	16.09%	14.35%	17.36%	16.90%	1.27%	2.55%	1.28%
Able to Cover Current Debt	61.60%	50.32%	60.22%	59.08%	-1.38%	8.76%	10.14%
Did Not Report DSCR	22.31%	35.32%	22.42%	24.02%	0.11%	-11.30%	-11.41%
<b>Market Characteristics</b>							
Distance to Nearest Large (>100 bed) Hospital (miles)	34.00	26.11	34.35	27.44	0.35	1.33	0.98
Market Share (cases) Captured (%)	24.11%	24.16%	22.69%	22.83%	-1.42%	-1.33%	0.09%
Market Total Population (millions)	3.25	6.02	3.22	5.33	-0.03	-0.69	-0.66
Market Unemployment Rate (%)	8.08%	8.50%	8.40%	8.68%	0.32%	0.18%	-0.14%
<b>Region (%)</b>							
South	35.52%	40.03%	-	-	-	-	-
Midwest	40.97%	44.69%	-	-	-	-	-
Northeast	6.97%	12.37%	-	-	-	-	-
West	19.54%	2.91%	-	-	-	-	-
Medians for continuous variables, means for non-continuous variables.							
Missing values: CCR (49 obs) FTEs per Bed (134 obs) Size (33 obs) Distance (59 obs) Market Share (59 obs) Population (59 obs) Unemployment Rate (59 obs)							

**Figure 4.3: Unadjusted Annual Averages by Merger Status**

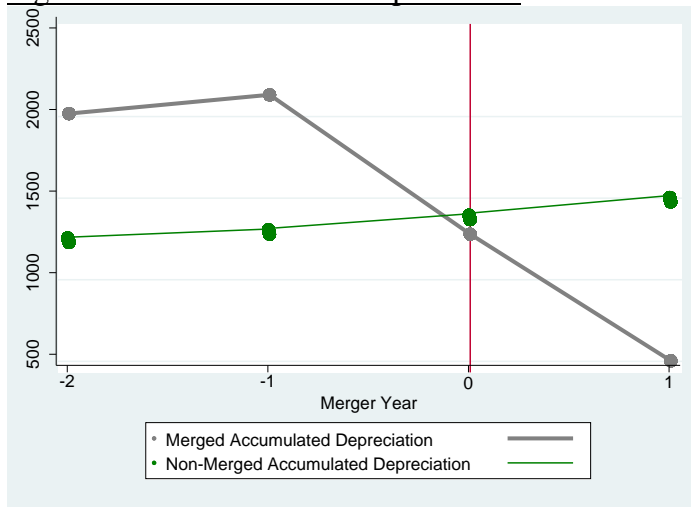
**Figure 4.3A: Total Capital Expenditures**



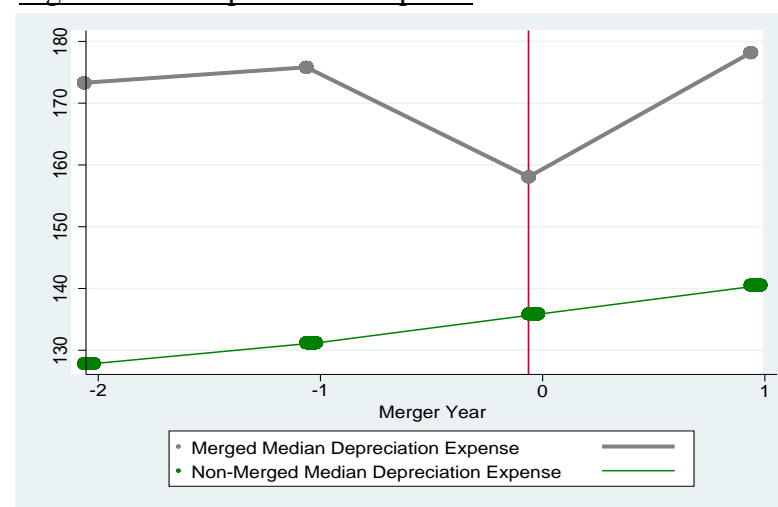
**Figure 4.3B: Plant Age**



**Figure 4.3C: Accumulated Depreciation**



**Figure 4.3D: Depreciation Expense**



**Table 4.3: Adjusted Difference-in-Differences Effect of Merging on Total Capital Expenditures at Rural Hospitals, 2012 – 2015**

Outcomes	Estimates
Total Capital Expenditures (Natural Log)	
Year After Event (Ref: Year Prior to Event)	1.30%
Merging	1.25%
Adjusted difference-in-differences	26.35%***
Proportion of Total Capital Expenditures to Total Revenue	
Year After Event (Ref: Year Prior to Event)	0.11%
Merging	-0.65% <sup>+</sup>
Adjusted difference-in-differences	-0.33%
Total Revenue (Revenue, Natural Log)	
Year After Event (Ref: Year Prior to Event)	1.15%
Merging	6.97%***
Adjusted difference-in-differences	-1.62% <sup>+</sup>
Net Patient Revenue (Revenue, Natural Log)	
Year After Event (Ref: Year Prior to Event)	1.01%
Merging	7.61%***
Adjusted difference-in-differences	0.03%
Total Discharges (Natural Log)	
Year After Event (Ref: Year Prior to Event)	-0.34%
Merging	8.12%***
Adjusted difference-in-differences	2.54%**
Acute Daily Census	
Year After Event (Ref: Year Prior to Event)	2.68***
Merging	3.43**
Adjusted difference-in-differences	0.72
+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001	



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## CHAPTER 5. SUMMARY OF FINDINGS AND IMPLICATIONS FOR PRACTICE, POLICY, AND RESEARCH

### Summary of Findings and Implications

The goals of this dissertation were to determine 1) when and how many rural hospitals merged, 2) pre-merger hospital- and market-level antecedents of rural hospitals, and 3) whether post-merger inpatient charges, outpatient charges and capital expenditures changed at target rural hospitals. Four primary findings from this research improve our understanding of merger impacts on rural hospitals and how rural hospital mergers compare to non-rural mergers.

First, I identified the number, timing, and location of rural hospitals that merged. To evaluate what types of rural hospitals merged and post-merger impacts, it was important to first determine which rural hospitals merged in the sample period. I found approximately eleven percent of all rural hospitals ( $n=326$ ) merged between 2005 and 2016. Of those, more than two-thirds ( $n=261$ ) merged after 2011. Also of importance, rural mergers were not equally dispersed across geographic regions; nearly ninety percent of merged rural hospitals were in the south or Midwest. While studies have found U.S. hospital merger activity increased significantly since 2010,<sup>1</sup> no known study prior to this research evaluated if the merger trend applied to rural hospitals. Findings from this study confirmed rural hospital mergers followed a similar upward trend as non-rural hospitals and impacted some regions of the country more than others.

Second, I determined pre-merger differences between the types of rural hospitals that merged and those that did not merge for several hospital- and market-level characteristics. Prior to this study, relatively little evidence existed on rural hospital merger antecedents.<sup>2</sup>

Understanding the types of rural hospitals that merged could help policy-makers and hospital

leaders anticipate future merger activity. My findings suggested rural hospitals with higher odds of merging were less profitable, less likely to be able to cover current debt, and operating older facilities. These findings were consistent with Noles et. al.<sup>2</sup> and implied that rural hospitals were financially weaker in the pre-merger period than non-merged rural hospitals. Worse pre-merger financial performance, debt burden, and plant age associated with higher odds of merging may have suggested rural hospitals merged to improve profits, payoff existing debt, and/or access capital to replace aging facilities. My findings also suggested rural hospitals with higher odds of merging were closer to the nearest large hospital, for-profit, and larger. Previous work found proximity, measured between target hospital and the nearest large hospital, was associated with a higher likelihood of U.S. hospitals (e.g., not specifically rural) merging.<sup>3,4</sup> The association of for-profit ownership with higher odds of rural hospitals merging contradicted a previous finding that not-for-profit U.S. hospitals were more likely to merge, particularly with other not-for-profits.<sup>4</sup> Being closer to the nearest large hospital and larger may have suggested acquirers sought a rural target to increase market power. The ability of an acquirer to use a rural merger to increase market power is important because of the potential benefits of increasing market power. Prior work has shown increased market power can be used to improve financial performance by coordinating services across sites<sup>5,6</sup> and reducing costs through staff and site consolidations.<sup>7</sup>

Third, I determined inpatient and outpatient charges changed at rural hospitals after merging. If a merger impacted service provisions in any way, rural hospitals and the communities they serve could be at risk because of access to care barriers that are more prevalent in rural areas.<sup>8-12</sup> In this study, I showed merging was associated with a decrease in inpatient charges and a statistically insignificant but a potentially clinically significant increase in outpatient charges at rural hospitals after a merger. Further, I found merging was not associated

with a change in inpatient volumes, a finding that contradicted prior U.S. merger (e.g., not rural-specific) results.<sup>3,13</sup> However, sample, time period, and methodological differences between previous research and my study made it difficult to compare results. My research evaluated a more recent sample of merged hospitals, providing more current insight into changes in inpatient discharges associated with merging. In the only known research in the past fifteen years to determine post-merger impacts at rural hospitals, Noles indicated she found no support for a shift from inpatient to outpatient services.<sup>14</sup> By contrast, I found a clinically significant increase in outpatient charges associated with merging, which may have implied there was a change in outpatient services due to merging; though more work would be necessary to make any association between changes in outpatient charges and outpatient services provided.

Fourth, I determined capital expenditures changed at rural hospitals after merging. I conducted this research because no known research had previously empirically tested for post-merger changes in capital expenditures. I found post-merger capital expenditures increased by a significant 26%. Additional evidence suggested that increase was partially attributable to facility renovations and replacements. My findings supported and quantified a top merger motive given by executives from merged U.S. (not specifically rural) hospitals in two 2017 industry surveys.<sup>15,16</sup> In my first study, I determined rural hospitals with worse financial performance, a lower likelihood to afford current debt, and operating older facilities had higher odds of merging. These findings suggested some rural hospitals merged to increase capital spending and, post-merger, that expectation was realized.

### **Future Research**

Future research can build upon the contributions from this dissertation to answer the following questions. Are legislative and economic factors associated with whether rural hospitals

merge? How do merger impacts vary among different types of merged rural hospitals? And, how do mergers impact the health of rural residents and the local economy?

In the first study, I determined the association of many rural hospital- and market-level antecedents. Future work could focus on the relationship between policy changes (e.g., the 2009 HITECH Act, the 2010 ACA, and the 2015 MACRA) and macroeconomic events (e.g., the 2007-2008 financial crisis) with merging and post-merger effects. Hospital markets likely have changed in material ways between rural and non-rural communities in recent years. Such work would be relevant for policy-makers weighing the intended and unintended impact of policies on the ability of rural hospitals to meet those requirements.

Throughout the dissertation, I drew conclusions for “typical” merged rural hospitals. I found some support for my expectation that, on average, rural hospitals merged to survive and acquirers targeted rural hospitals that could be used to improve market power. It is likely that merged hospitals were composed of multiple subpopulations. Some rural hospitals may have merged to survive. Others may have merged for strategic reasons, such as to improve the health of the local population. These differences could lead to vastly different post-merger outcomes. Such work is unexplored but necessary for decision-makers to appropriately respond to merger opportunities and post-merger impacts. In unreported exploratory work, I discovered that the effect of merging on capital expenditures varied substantially by the age of the rural hospital facilities. Specifically, rural hospitals operating the oldest facilities benefited the most, followed by the newest facilities. There was much less of an impact on facilities with average plant age. These findings led me to suspect different motives for merging among rural hospitals based on the age of hospital facilities. Rural hospitals with the oldest facilities may have been the most motivated to merge to increase capital expenditures on renovations and replacements. Rural



hospitals with the newest facilities may have merged for potentially more strategic reasons, which could have led to an increase in capital investments in new technology or service expansion. I hope colleagues will continue advancing our understanding of how mergers impact rural hospitals in different ways.

The next logical step for rural hospital merger research is to determine the impact of mergers on the health of rural community members and on the local economy. It is not practical for rural hospitals to provide the breadth of services offered by larger regional hospitals, as that could lead to the inefficient use of resources and quality concerns due to low volumes of certain procedures.<sup>19,17</sup> However, it is critical to provide time-sensitive services for conditions like heart attacks, seizures, and stroke locally. Perhaps rural decision-makers should consider alternatives for many of these services in rural areas, including but not limited to telehealth services, enhanced referral relationships, and better transfer protocols. It is also possible that restructuring some rural hospitals into freestanding emergency departments<sup>18</sup> or micro-hospitals could provide a more effective and cost-conscious way to deliver care. However, because the rural hospital is often the largest employer in the community,<sup>19</sup> changes to care delivery could have indirect consequences on the local economy. After a rural hospital closes, one study found per capita income declined 4 percentage points while unemployment rose 1.6 percentage points.<sup>20</sup> Future research on merging and these complex outcomes is important for lawmakers and rural decision-makers tasked with maintaining the delicate balance between the most financially viable option and what is best for the community.

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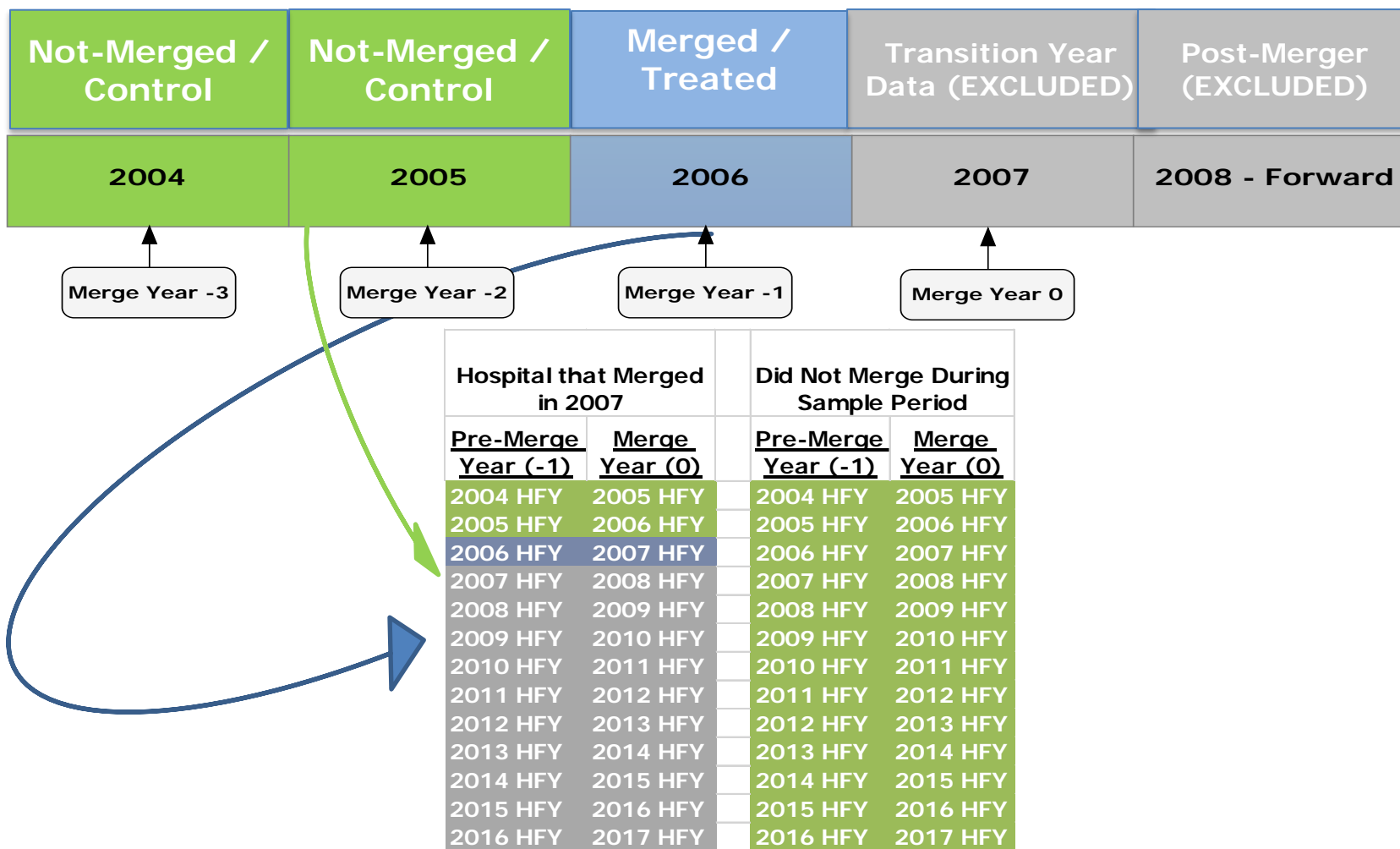
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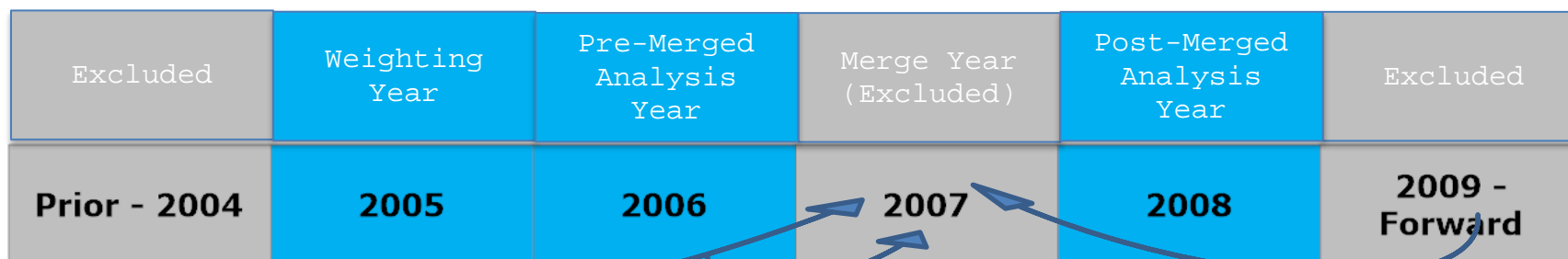
## **APPENDIX 1: INCLUSION/EXCLUSION CRITERIA FOR RURAL HOSPITALS BASED ON MERGER STATUS**

Consider a rural hospital in Oklahoma that merged in 2007. Because this hospital reported cost reports for all years of the sample period, it was included in the treatment group once (e.g., 2006) and in the control group twice (e.g., 2004 and 2005) (as represented by the blue and green years, respectively, in Figure A.1). While this hospital did not merge prior to 2007, we considered it a valid comparison to hospitals that merged in those years. Because we limited our analysis to the first merger during our study period, we exclude merged hospitals from re-entering the comparison group post-merger (gray in Figure A.1). Rural hospitals that did not merge during the sample period but reported cost report data for each of the twelve analytical years (2004-2015) were included in the comparison group all twelve years (represented as the green years in the bottom right image of Figure A.1).

Figure A.1: The Inclusion of Merged Hospitals in Treatment and Comparison Group Analytical Year



## APPENDIX 2: INCLUSION CRITERIA FOR MERGED AND WEIGHTED NON-MERGED RURAL HOSPITALS



**To be included as a merged or weighted non-merged:**  
 Must report non-missing outcome data in years -2, -1, and +1

Hospital that Merged in 2007				Hospital that Did Not Merge During Sample Period (But Reported Data)			
Weight Year (-2)	Pre-Merge Year (-1)	Merge Year (0)	Post-Merge Year (+1)	Weight Year (-2)	Pre-Merge Year (-1)	Merge Year (0)	Post-Merge Year (+1)
2003 HFY	2004 HFY	2005 HFY	2006 HFY	2003 HFY	2004 HFY	2005 HFY	2006 HFY
2004 HFY	2005 HFY	2006 HFY	2007 HFY	2004 HFY	2005 HFY	2006 HFY	2007 HFY
2005 HFY	2006 HFY	2007 HFY	2008 HFY	2005 HFY	2006 HFY	2007 HFY	2008 HFY
2006 HFY	2007 HFY	2008 HFY	2009 HFY	2006 HFY	2007 HFY	2008 HFY	2009 HFY
2007 HFY	2008 HFY	2009 HFY	2010 HFY	2007 HFY	2008 HFY	2009 HFY	2010 HFY
2008 HFY	2009 HFY	2010 HFY	2011 HFY	2008 HFY	2009 HFY	2010 HFY	2011 HFY
2009 HFY	2010 HFY	2011 HFY	2012 HFY	2009 HFY	2010 HFY	2011 HFY	2012 HFY
2010 HFY	2011 HFY	2012 HFY	2013 HFY	2010 HFY	2011 HFY	2012 HFY	2013 HFY
2011 HFY	2012 HFY	2013 HFY	2014 HFY	2011 HFY	2012 HFY	2013 HFY	2014 HFY
2012 HFY	2013 HFY	2014 HFY	2015 HFY	2012 HFY	2013 HFY	2014 HFY	2015 HFY
2013 HFY	2014 HFY	2015 HFY	2016 HFY	2013 HFY	2014 HFY	2015 HFY	2016 HFY

### **APPENDIX 3: MERGER IDENTIFICATION**

Hospitals must have met certain criteria to be included as a merged rural hospital in this research. Rurality was defined according to the Federal Office of Rural Health Policy definition: short-term, nonfederal general facilities located outside Metropolitan Core-Based Statistical Areas (CBSAs) or within Metropolitan areas and having Rural-Urban Commuting Area (RUCA) codes of four or greater or with CAH status.<sup>21</sup> A merger was defined as the reorganization of two or more entities resulting in the majority ownership of a hospital. The Irving Levin data reported a merger “announcement date,” which may have: 1) included hospitals that did not merge during the sample period and 2) represented a date other than that on which ownership transferred.

#### **Effective Date**

To address any discrepancies between the announcement date and the actual merger date, in this dissertation an “effective date” was identified to measure if and when ownership transferred. Whether 1) a hospital met this definition of a merger and 2) a merger effectively occurred was verified through searching publicly-available documents online (e.g., for-profit IRS Form 10-Ks, not-for-profit IRS Form 990s, and annual reports from hospital websites) and, when necessary, calling and emailing leaders of rural hospitals. From the Levin data, I identified 395 rural hospitals that were announced to have merged. Of those, I determined that 379 effectively merged. The difference is reconciled in Table A.1.

**Table A.1: Reconciling the Number of “Announced” versus “Effectively” Merged Rural Hospitals**

<b>Merged Hospital Identification</b>		
Announced merged rural hospitals (Source: Irving Levin data, 2005-2016)		395
Drop if did not merge	(9)	386
Drop if still pending	(6)	380
Drop if entered a management agreement or affiliation, not a merger	(3)	377
Add if identified an effective merger that was not announced by Levin	+2	<u>379</u>
<b>Total Rural Hospital Mergers that Met My Definition of a Merger:</b>		<b>379</b>

The effective date was more precise than the announcement date because it captured the same moment of ownership transfer at every merged hospital. I determined that the announcement dates differed noticeably from the effective date.<sup>22</sup> On average, the effective date occurred 109 days prior to the announced date. Compared to the announced date, the effective date occurred after 76% of the time and prior to 5% of the time. The announced and effective date were the same only 19% of the time.

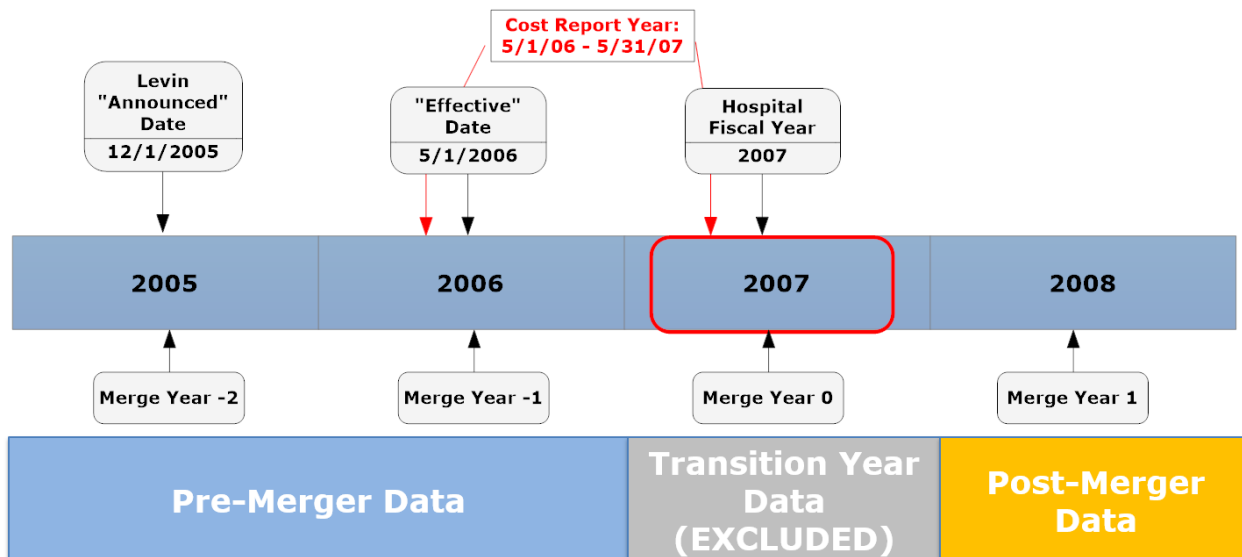
#### **Effective Merger Year**

I reconciled the merger effective date to each hospital’s fiscal year (HFY) by the following process. I began with the HFY from CMS cost reports. The HFY differs from the calendar year (CY) approximately two-thirds of the time.<sup>23</sup> Therefore, the CY from the merger effective date often did not align with the year from the HFY. Because I analyzed data based on years, not specific dates within a year, it was necessary to align effective merger dates with the correct HFY.



I demonstrated the process of reconciling Levin’s announced merger date, my effective date, and the HFY with the following example in Figure A1. Levin announced that Via Christi Oklahoma Regional Medical Center in Ponca City, Oklahoma merged as of 12/1/2005. I determined from an IRS document submitted by the acquirer, Community Health System, that the effective date of that merger was 5/1/2006. Thus, the CY for the announced date (2005) differed from the CY of the effective date (2006). I then determined in what HFY the effective date occurred. For Ponca City, the HFY for 2007 ran from 5/1/06-5/31/07. In this case, Ponca City changed its HFY reporting period after 2006 (pre-merger) and began a new HFY period in 2007, which began on the date of merger. That led to an abbreviated 2006 HFY (10/01/2005-4/30/2006, not reported) and an extended thirteen-month 2007 HFY. From 2008 on, Ponca City reported twelve-month HFYs spanning from 6/01 – 5/31. The result is that Ponca City’s announced date occurred in CY2005, the effective date occurred in CY2006, but the effective date fits within the HFY 2007. Thus, Ponca City was considered merged in 2007.

**Figure A.2: Assigning Merger Year**



In another scenario, the effective merger date did not fit within any HFY >360 days. In those cases, I aligned the effective merger date with the beginning or end date from the HFY > 360 days that was closest in number of days to the effective date. This may best be described by an example. I determined the effective merge date for Medical Park Hospital in Hope, Arkansas was 12/1/2005. However, Hope reported two cost reports for HFY 2005, one from 7/1/2004 – 6/30/2005 and a second from 7/1/2005-12/31/2006. The second cost report was dropped because it did not meet my inclusion criteria that a cost report must have at least 360 days in a period. Thus, my data included only one 2005 HFY cost report (7/1/2004 – 6/30/2005). However, the effective merge date of 12/1/2005 did not occur during HFY 2005 or HFY 2006 (1/1/2006 – 12/31/2006). I aligned the effective merge date with HFY 2006 because that date was closer to the beginning date of HFY 2006 (1/1/06) than the end date of HFY 2005 (6/30/2005).

#### **Annual Number of Mergers by Hospital Fiscal Year**

In Table A.2, I reconciled annual differences in the announced year, effective year, and hospital fiscal year.

**Table A.2: Assigning Merger Year**

<u>Calendar Year</u>	<u>Announced Year</u>	<u>Effective Year</u>	<u>Hospital Fiscal Year</u>
2005	22	21	8
2006	35	32	35
2007	21	13	18
2008	18	19	19
2009	16	11	15
2010	20	22	16
2011	27	20	22
2012	57	36	28
2013	49	40	43
2014	44	70	65
2015	56	57	60
2016	30	38	38
2017	0	0	12
	<b>395</b>	<b>379</b>	<b>379</b>

For the 379 rural hospital mergers, the announced date differed from the effective HFY 241 times, or 64% of the time, as shown in the right column of Table A.3. Also in Table A.3, I show that it was necessary to reconcile the effective date CY with the HFY, because those years differed 108 times, or 29% of the time (middle column of Table A.3). Through my reconciliation process, twelve mergers occurred in HFY 2017, even though the Levin announced data I use only spans through 2016. Formally, I tested for statistical differences in my outcome variables by announcement year and HFY (reported in Chapter 2, Implications).<sup>24</sup>

**Table A.3: Reconciling Merger Dates**

<u>Calendar Year</u>	<u>Effective vs Hospital Fiscal Year</u>	<u>Announced vs Hospital Fiscal Year</u>
2005	13	0
2006	10	14
2007	5	13
2008	5	13
2009	1	13
2010	8	9
2011	6	13
2012	13	15
2013	10	40
2014	15	46
2015	11	32
2016	11	21
2017	0	12
	<b>108</b>	<b>241</b>

### Sample

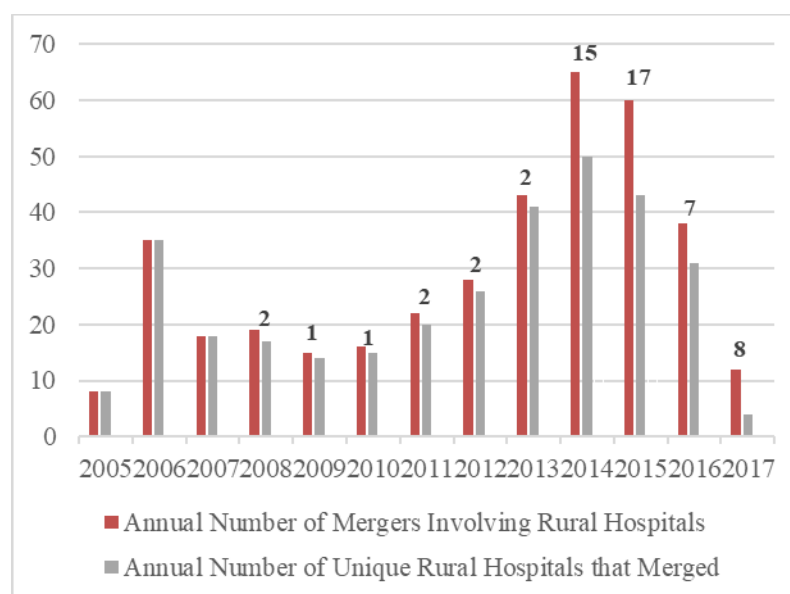
The sample for Aim 1 included 282 rural hospitals that merged and 22,568 hospital years for rural hospitals that did not merge during the sample period. To define the sample, I began with data for all rural hospitals that filed Medicare Cost Reports from 2004–2016. I excluded all partial-year cost reports reporting for less than 360 days (n=2,186).

Next, I determined which rural hospitals merged more than one time during the sample period and excluded any merger after the first merger (n=53). There were 326 unique rural hospitals that merged. Of those, 39 merged more than once, as displayed in Figure A.2. Of the 39 multi-merged rural hospitals, 28 merged twice (excluded 28 merges), 9 merged three times (excluded 18 merges), 1 merged four times (excluded 3 merges), and 1 merged five times (excluded 4 merges), as displayed in Figure A.3.

**Figure A.3: Reconciling the Number of Total Rural Hospital Mergers and Unique Rural Hospitals that Merged**

Reconciliation of Total Rural Mergers (379) and Unique Rural Hospitals that Merged (326)			
	Total # of Mergers:	Unique Mergers:	
Rural Hospitals that Merged Only Once During the Sample	287	287	287
Rural Hospitals that Merged Exactly Twice During the Sample	343	28	315
Rural Hospitals that Merged Exactly Three Times During the Sample	370	9	324
Rural Hospitals that Merged Exactly Four Times During the Sample	<u>374</u>	1	325
Rural Hospitals that Merged Exactly Five Times During the Sample	379	<u>1</u>	<u>326</u>
<b>Unique Rural Hospitals that Merged</b>		<b>326</b>	<b>326</b>

**Figure A.4: The 53 Excluded Multi-Mergers from the 39 Rural Hospitals That Merged More than Once**



#### APPENDIX 4: INVERSE PROBABILITY OF TREATMENT WEIGHTING (STUDIES 2 AND 3)

Weighting improved balance for all three outcomes in studies 2 and 3. For example, in the figure below for inpatient revenue, the unmatched difference between merged and non-merged rural hospitals was 0.84 and statistically significant (t-stat=8.75). After weighting, that difference was 0.05 and statistically insignificant (t-stat=0.38).

<b>Variable</b>	<b>Sample</b>	<b>Treated</b>	<b>Controls</b>	<b>Difference</b>	<b>S.E.</b>	<b>T-stat</b>
Inpatient Revenue (logged)	Unmatched	17.21	16.37	<b>0.84</b>	0.10	8.75
	ATT	17.21	17.16	<b>0.05</b>	0.13	0.38
Outpatient Revenue (logged)	Unmatched	17.72	16.93	<b>0.78</b>	0.09	8.78
	ATT	17.72	17.73	<b>-0.01</b>	0.11	-0.10
Total Capital Expenditures (logged)	Unmatched	13.95	13.54	<b>0.41</b>	0.18	2.30
	ATT	13.95	14.08	<b>-0.13</b>	0.22	-0.56

## APPENDIX 5: REGRESSION OUTPUT

Full regression results for each study are presented below. In Table A.4, I present regression results for study one. From left to right, columns represent: variable names, odds ratio, bootstrapped standard errors, the z-score, the p-value of the z-score, and the 95% confidence interval.

In Table A.5, I present regression results for study 2. The left columns present regression estimates for the inpatient charges outcome. The right columns present regression estimates for the outpatient charges outcome. Beta estimates are to the right of variables. Ninety-five percent confidence intervals are below estimates. At the bottom, of Table A.5, the rho estimate suggests a larger proportion of error variance is due to non-random within cluster variance ( $\sigma_u$ ) than due to between cluster idiosyncratic variance ( $\sigma_e$ ). Because I cluster at the hospital-level, this suggests there may be additional variation unexploited by my analysis. Due to the two time-periods of analysis, I cannot exploit these differences using hospital-level fixed effects. In order to do so, I would need a more in-depth panel of data across multiple years. The higher log-likelihood from the inpatient charges model (left side) is higher than the outpatient charges model and therefore is the model from which I should interpret covariate estimates. The AIC from the inpatient charges model is lower than the outpatient charges model and would also support my choice to interpret estimates from the inpatient, as compared to the outpatient, model. In Table A.6, I present regression results for study 3. The format and interpretations for Table A.6 follow the same description as Table A.5.

**Table A.4: Study 1: Factors Association with Rural Hospitals Prior to Merger**

	Odds Ratio	Bootstrapped SE	z	P> z	[95% CI]	
Total Margin	0.97***	0.01	-3.85	0.000	0.95	0.98
FTEs per Bed	0.97	0.03	-1.15	0.250	0.92	1.02
Medicare CCR	0.99	0.01	-1.34	0.180	0.98	1.00
Ability to Cover Current Debt						
Did Not Report DSCR	1.14	0.23	0.66	0.510	0.77	1.69
Unable to Cover Current Debt	0.64*	0.12	-2.34	0.019	0.45	0.93
Medicare Outpatient Payer Mix	0.99	0.01	-1.08	0.278	0.97	1.01
Hospital Provides Obstetrics	0.47***	0.10	-3.54	0.000	0.31	0.71
Ownership Status						
For-Profit	1.71*	0.45	2.02	0.044	1.01	2.88
Government	0.60**	0.12	-2.62	0.009	0.40	0.88
Average Plant Age (quartiles)						
Percent in Second Newest Quartile	1.28	0.27	1.19	0.234	0.85	1.93
Percent in Second Oldest Quartile	1.53*	0.33	1.96	0.050	1.00	2.34
Percent in Oldest Quartile	1.62*	0.37	2.09	0.036	1.03	2.53
Size (Net Patient Rev, quartiles)						
Percent in Second Smallest Quartile	2.20*	0.67	2.59	0.010	1.21	4.00
Percent in Second Largest Quartile	3.40***	1.16	3.58	0.000	1.74	6.64
Percent in Largest Quartile	4.50***	1.88	3.60	0.000	1.98	10.22
CAH	1.15	0.26	0.61	0.545	0.74	1.78
Distance to Nearest Large (>100 bed) Hospital (logged)	0.77*	0.09	-2.34	0.020	0.62	0.96
Market Share (cases) Captured	1.00	0.01	0.52	0.603	0.99	1.02
Market Total Population (logged)	1.20	0.17	1.27	0.204	0.91	1.58
Market Unemployment Rate	0.99	0.03	-0.30	0.763	0.94	1.04
Region						
Midwest	1.06	0.23	0.29	0.772	0.70	1.61
Northeast	1.07	0.27	0.26	0.793	0.65	1.77
West	0.26**	0.12	-2.94	0.003	0.11	0.64
Hospital Fiscal Year						
2005	3.76**	1.68	2.96	0.003	1.56	9.03
2006	1.51	0.77	0.81	0.415	0.56	4.09
2007	0.95	0.51	-0.10	0.919	0.33	2.72
2008	1.04	0.55	0.08	0.935	0.37	2.91
2009	0.74	0.42	-0.52	0.601	0.25	2.25
2010	1.30	0.65	0.53	0.593	0.49	3.46
2011	2.57*	1.17	2.07	0.038	1.05	6.29
2012	3.75**	1.68	2.95	0.003	1.56	9.02
2013	5.28***	2.32	3.79	0.000	2.23	12.49
2014	3.50**	1.59	2.75	0.006	1.43	8.55
2015	3.07**	1.39	2.48	0.013	1.26	7.46
Constant	0.0023**	0.0043	-3.2300	0.001	0.0001	0.0919



**Table A.5: Study 2: Inpatient and Outpatient Charges (logged) Regressions**

Inpatient Revenue (logged)	b / [95% CI]	Outpatient Revenue (logged)	b / [95% CI]
Post	0.0011698 [-.0044111,.0067507]	Post	-0.0048029 [-.0113873,.0017816]
Treat	.1773465*** [.1596608,.1950323]	Treat	.1265576*** [.1080075,.1451077]
Treat*Post	-.030419*** [-.0395755,-.0212626]	Treat*Post	0.0106622 [-.0013685,.0226929]
CAH Status		CAH Status	
Non-CAH, PPS	0 [0,0]	Non-CAH, PPS	0 [0,0]
PPS	-.3471906*** [-.364055,-.3303261]	PPS	-.1047801*** [-.122174,-.0873862]
Ownership Status		Ownership Status	
Not-for-Profit	0 [0,0]	Not-for-Profit	0 [0,0]
For-Profit	.117777*** [.1011252,.1344289]	For-Profit	-.1739198*** [-.1929901,-.1548495]
Government	-.1125516*** [-.1247425,-.1003608]	Government	-.1156388*** [-.1288869,-.1023908]
Hospital Provides Obstetrics		Hospital Provides Obstetrics	
Does Not Provide OB	0 [0,0]	Does Not Provide OB	0 [0,0]
Provides OB	.3420942*** [.3289518,.3552366]	Provides OB	.3706836*** [.3563371,.3850301]
Days in Period	.0029938*** [.0021629,.0038247]	Days in Period	.0026516*** [.0015811,.003722]
Medicare CCR	-.011819*** [-.0121755,-.0114624]	Medicare CCR	-.0164*** [-.0168156,-.0159844]
FTEs per Bed	.0355371*** [.0345835,.0364907]	FTEs per Bed	-.017821*** [-.018937,-.016705]
Distance to Nearest Large (>100 bed) Hospital (logged)	-.1150165*** [-.1239938,-.1060391]	Distance to Nearest Large (>100 bed) Hospital (logged)	-.0822863*** [-.092215,-.0723575]
Market Total Population (logged)	.7358543*** [.7275772,.7441313]	Market Total Population (logged)	.5668455*** [.5579055,.5757854]
Market Unemployment Rate	.0054495*** [.0037788,.0071202]	Market Unemployment Rate	.0131921*** [.0112741,.0151101]
Market Share (cases) Captured	.0307042*** [.0302372,.0311713]	Market Share (cases) Captured	.0194856*** [.0189629,.0200082]
Region		Region	
South	0 [0,0]	South	0 [0,0]
Northeast	-0.0123762 [-.0281199,.0033675]	Northeast	.2658663*** [.2496258,.2821068]
Midwest	.0428214*** [.0178195,.0678233]	Midwest	.3857438*** [.3600187,.4114688]
West	-.0381309*** [-.0582696,-.0179922]	West	.252036*** [.2311425,.2729295]

Hospital Fiscal Year		Hospital Fiscal Year	
2004	0	2004	0
	[0,0]		[0,0]
2005	.0524485***	2005	.0671505***
	[.0292373,.0756597]		[.0400361,.094265]
2006	.1012861***	2006	.18798***
	[.0876868,.1148854]		[.1705721,.205388]
2007	.1672894***	2007	.2662003***
	[.1453293,.1892496]		[.2410315,.2913691]
2008	.2041517***	2008	.3980772***
	[.1863473,.2219561]		[.3762686,.4198858]
2009	.2929926***	2009	.5266261***
	[.2706394,.3153459]		[.5012547,.5519975]
2010	.2802729***	2010	.5995755***
	[.2598883,.3006575]		[.5755698,.6235812]
2011	.3146161***	2011	.6564698***
	[.2911944,.3380377]		[.6303576,.682582]
2012	.290218***	2012	.7128142***
	[.267625,.312811]		[.6871727,.7384556]
2013	.3610534***	2013	.8301223***
	[.3357428,.3863641]		[.8025514,.8576931]
2014	.3405547***	2014	.8418343***
	[.3154657,.3656437]		[.8141873,.8694813]
2015	.4297554***	2015	.9869237***
	[.4007105,.4588003]		[.9553495,1.018498]
2016	.3924693***	2016	1.011268***
	[.3634081,.4215305]		[.9793962,1.043139]
Constant	7.318408***	Constant	9.953886***
	[6.992679,7.644138]		[9.542213,10.36556]
Sigma_u	.4617786***	Sigma_u	.458806***
	[.4570372,.4665199]		[.4538388,.4637733]
Sigma_e	.190251***	Sigma_e	.2508597***
	[.1884631,.1920388]		[.2485323,.2531871]
Rho	0.85	Rho	0.77
LL	-19341.5	LL	-26588.64
AIC	38746.99	AIC	53241.29

**Table A.6: Study 3: Total Capital Expenditures (logged) Regression**

Total Capex (logged)			
	b / [95% CI]		b / [95% CI]
Post	0.0130488	FTEs per Bed	.0285219***
	[-.045687,.0717846]		[.0238041,.0332396]
Treat	0.0124548	Distance to Nearest Large (>100 bed) Hospital (logged)	0.019893
	[-.0623889,.0872984]		[-.0201356,.0599216]
Treat*Post	.2635406***	Market Total Population (logged)	.7110541***
	[.1639361,.3631451]		[.6765445,.7455637]
CAH Status		Market Unemployment Rate	0.0045118
Non-CAH, PPS	0		[-.0032589,.0122825]
	[0,0]	Market Share (cases) Captured	.0297595***
PPS	-0.002335		[.0275022,.0320167]
	[-.0626368,.0579669]	Region	
Ownership Status		Northeast	0
Not-for-Profit	0		[0,0]
	[0,0]	Midwest	.2312156***
For-Profit	-.4705149***		[.1728587,.2895724]
	[-.5568698,-.3841601]	South	.3310206***
Government	0.0046603		[.2419634,.4200777]
	[-.0464082,.0557287]	West	.080014*
Hospital Provides Obstetrics			[.004506,.1555219]
Does Not Provide OB	0	Hospital Fiscal Year	
	[0,0]	2011	0
Provides OB	.3060213***		[0,0]
	[.2497855,.3622571]	2012	-0.0204439
Days in Period	.019629***		[-.1048809,.0639931]
	[.0083409,.030917]	2013	0.0637321
Medicare CCR	-.0058631***		[-.0147542,.1422184]
	[-.007688,-.0040382]	2014	0.0324656
Average Plant Age (quartiles)			[-.0498184,.1147496]
Percent in Newest Quartile	0	2015	-0.0324104
	[0,0]		[-.1376033,.0727824]
Percent in Second Newest Quartile	-0.0560502	2016	0.0357639
	[-.1196482,.0075477]		[-.0718767,.1434045]
Percent in Second Oldest Quartile	-.196756***	Constant	-1.958325
	[-.259256,-.1342559]		[-6.129618,2.212969]
Percent in Oldest Quartile	-.3980301***		
	[-.4610368,-.3350234]	Sigma_u	.4885955***
Ability to Cover Current Debt			[.446804,.530387]
Did Not Report DSCR	0		
	[0,0]	Sigma_e	1.269288***
Unable to Cover Current Debt	.2556603***		[1.249948,1.288628]
	[.1965774,.3147432]	Rho	0.1290536
Able to Cover Current Debt	0.0154194	LL	-29893.11
	[-.0543517,.0851905]	AIC	59846.22