The Impact of Financial changes on Hospital Quality of Care: Evidence from State Medicaid Expansion

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Abstract

Understanding the relationship between hospital financial condition and quality of care is integral for policy makers and administrators as changes in financial condition can have drastic impacts on quality of care, mortality, and quality of life. Using previously established research surrounding Medicaid expansion and hospital finances, I use the expansion of Medicaid as natural experiment to test whether changes in financial conditions impacts hospital quality of care. Using publicly available hospital quality data, I examine if hospitals in states that expanded Medicaid (and those shown to be more financially better off) experience greater improvements in quality of care. A difference in differences regression approach is utilized that studies pre and post hospital trends in quality to determine the impact on quality of care. I extend this further to examine rural hospitals since they were impacted at a greater financial magnitude by expansion to see if there is a possible dose relationship.

My findings show that rural hospitals are impacted differently, however, the financial shock brought about by Medicaid expansion is not likely exogenous. That is, hospitals in expansion and non-expansion states have inherently different characteristics (observed and unobserved) that are in part correlated with the expansion. This results in inconsistent estimated impacts of Medicaid expansion across the two groups. While a concrete relationship between hospital financial performance and quality of care is not found, this research does contribute to the literature by using a natural experiment to disentangle the endogenous relationship between hospital financial performance and quality of care. This research also serves as a lesson that rigorous testing of natural experiments are needed, and that future research examining the impacts of Medicaid expansion on hospital quality should be approached cautiously.

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It often "takes a village" for an individual to complete these types of things, and nothing could be truer for me. My family has provided me with great support and motivation throughout this process, and while my name is on this document as the author, the efforts of my family have made it possible for this process to be completed – without them, none of this was possible. To my wife Emily, thank you for the endless weekends of watching the children while I completed this journey and for continually encouraging (and pushing) me to finish. Your affirmation and support mean the world to me. To my daughters Gwendolyn and Anna Cate, you both make every day better and I hope that this is just one of many examples of perseverance that I teach you. I love you both dearly. Finally, to my mother – your wisdom and encouragement my entire life made me the person I am today, and I couldn't have wished for anything more.

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Chapter 1: Introduction

Hospital financial hospital performance plays an integral part in determining how the health delivery system delivers care to patients. Changes in financial performance have significant downstream impacts on care delivery in the short and long run (Bazzoli et al., 2007; Shen, 2003; Volpp, Konetzka, et al., 2005). This dissertation examines how changes in hospital financial performance impact the quality of care received by patients in the system. Understanding this relationship is important for policy makers and health administrators since many value-based arrangements and expansions of insurance coverage have clear impacts on hospital financial performance (A. M. Ryan, Burgess, Pesko, Borden, & Dimick, 2015). By better understanding the ultimate impacts brought about by these changes on quality of care (i.e. proper processes of care, mortality, readmissions, etc.), effective policies can be designed that address both patient safety and cost effectiveness. To date, most research has focused on outcomes measures like mortality and readmissions or patient satisfaction measures of quality to assess how financial changes impact quality of care. While these are valuable measures, this dissertation uses process of care measures, which has seldom been used in these types of analyses.

Recent policy changes established with the passage of the Affordable Care Act (ACA) in 2008 provide an opportunity to examine financial performance and quality of care in a natural experiment framework. The ACA marked a significant change in the healthcare landscape in the United States. The primary purpose of the law was to expand health insurance coverage to essentially all Americans through various programs and types of coverage. One such way this was accomplished was by the federal government providing more funds to states to expand their Medicaid programs. Medicaid has historically been an insurance program that covers children, the disabled, or individuals falling below a federal poverty level (FPL) threshold. As part of the

expansion, the ACA specified that the minimum threshold for income-based Medicaid eligibility be raised to at least 138%, which exceeded the existing standards in many states. This also included a provision to cover adults without children, who were generally not eligible for coverage before.

However, many states sued the federal government for overstepping its authority in mandating the expansion of Medicaid, even with additional federal funds to cover the new eligible beneficiaries. The Supreme Court ultimately ruled in favor of the states and allowed them the option to expand or not; going against the original design of the ACA. This decision resulted in 23 states electing to not expand coverage, which went into effect in 2014.

Medicaid expansion affects hospital financial performance because more patients have access to health insurance, which increases the demand for hospital services, and it lowers the amount of uncompensated care produced by hospitals because patients who were previously unable to pay now have a mechanism to do so. Using the differences in expansion decisions as a natural experiment where hospital in expanding states received a positive financial shock independent of other characteristics related to financial performance and quality. I examine how financial performance affects hospital quality of care measures. This approach has several key advantages for statistical identification. First, there are clear control and intervention groups. This allows a better comparison of quality of care/outcomes in hospitals with better financial performance. Another advantage of this approach is that it helps control for potential changes in the intervention group over time. By having a comparison group, we can “difference” out any time variant changes and approach an unbiased estimate of the impact that changes in hospital financial condition has on quality of care.

This statistical design is built on the premise that Medicaid expansion has a significant impact on hospital finances. This relationship is established by a broad body of research, which finds improved financial performance after expansion due to lower uncompensated care costs and higher volume (Blavin, 2016; Camilleri & Diebold, 2019; Dobson, DaVanzo, Haught, & Luu, 2017; David Dranove, Garthwaite, & Ody, 2016; Lindrooth, Perraillon, Hardy, & Tung, 2018). To date, the literature suggests better financial performance improves patient outcomes, however, there has been very little research conducted on how the Medicaid expansion has impacted the quality of care delivered in the hospital setting. This dissertation contributes to the literature in that it will be one of the only analyses that uses the natural experiment created by Medicaid expansion decisions to determine how quality of care is impacted.

Previous studies of hospital finance and quality of care have produced inconclusive results. This is due in large part to the difficulties in addressing the possibility that finance and quality are simultaneously determined or that there are two-directional causal effects between finance and quality. A hospital's quality of care impacts financial performance through reputation effects and ability to capture market share (Newhouse, 1970). Conversely, hospital financial performance also impacts the level of quality that can be produced since funding for adequate levels of staffing, capital improvements, and quality improvement initiatives is needed to ensure that optimal levels of quality can be achieved. A moderate amount of research has examined how financial performance has impacted hospital quality and outcomes, but most studies have not been able to account for the simultaneous and two-directional relationship between hospital financial performance and quality of care. This dissertation controls for this relationship is through the use of an exogenous financial shock caused by Medicaid expansion

and the use of control and intervention groups (states that expanded versus those that didn't) to address common trends and time effects.

The endogenous relationship between hospital finances and quality of care makes most non-experimental studies' results biased because of the feedback between the two variables. One way to "break" this relationship and establish the causal effect is through an exogenous shock that impacts one of the variables; in this case, financial performance. As stated before, there is clear evidence that hospitals in expansion states experienced improved financial performance via Medicaid expansion, so this will serve as the exogenous shock. Another methodological advantage of this study is that it has control and intervention groups. Most prior studies of the effects of financial performance on quality of care look at broad policies that impact all hospitals. A weakness of this design is that one cannot separate effects from trends or aggregate economic conditions from the treatment effect. An example of this type of design are studies using the Balanced Budget Act of 1997 (BBA). This policy restructured how hospitals were reimbursed by Medicare thus impacting virtually all hospitals in the United States and leaving no credible group of non-treated hospitals. The statistical design used in this dissertation addresses both endogenous relationships (simultaneity and two-directional effects) and the need to address time trends and effects. Specifically, time trends and effects are addressed by using a control group in a difference in differences (DD) framework. A DD model captures time trends and aggregate economic effects by eliminating the effects of existing trends in performance common to both the control and intervention group.

The difference in differences approach is beneficial, but it measures the *average effect* of an intervention on the intervention group. Since all hospitals are included in this analysis regardless of characteristics (rural/urban, patients served, bed size, etc.), the estimate of the

impact of financial changes on quality will be reported across all hospitals. However, additional analysis will also be conducted on the subset of rural hospitals in the sample because they have inherently different characteristics than their urban counterparts (Camilleri & Diebold, 2019; Dobson et al., 2017; Kaufman, Reiter, Pink, & Holmes, 2016). For example, and most pertinent to this study, rural hospitals rely more heavily on Medicaid as a source of revenue. This is very important from a policy and methodological perspective as these hospitals are more sensitive to the financial changes (changes in Medicaid coverage) studied in this dissertation. Policy makers should be interested in this due to the recent financial struggles faced by many rural hospitals and the ability of residents in these areas to have adequate access to care (Kaufman et al., 2016; Lindrooth et al., 2018).

Research Questions

This dissertation will examine the following two questions:

1. How do changes in hospital financial condition impact quality of care?
2. Do rural hospital experience larger changes in quality of care relative to urban counterparts?

While the works cited above generally focus on the link between financial performance and quality of care, there is very little information about what happens to care quality following an abrupt change in financial performance. Also, while there is a body of research examining how financial conditions impact hospital quality of care, there are methodological limitations common to many of the previous studies that limit the causal interpretation of their data. These limitations will be examined below in connection with the discussion of measure specification and research design. Finally, the current body of research is generally lacking in specific

consideration of relationship between financial performance and care quality in rural and critical access hospitals relative to their urban counterparts. Study Significance

This dissertation contributes the literature in several ways. First, the methodological approach used will offer stronger results that can be interpreted as causal. Using the difference in differences approach allows for a comparison between control and intervention groups. This is advantageous because we use the control group to see how the intervention group would have behaved in the absence of Medicaid expansion, and thus find the true impact of the intervention. Second, my measure of hospital quality is focused on processes of care, which is generally different from most other research in this area. To date, studies examining how financial changes impacts quality of care focuses on outcome measures like mortality and infection rates. Such studies are important, but other aspects of quality also need to be examined, like processes of care. Donabedian breaks down quality into three domains: structures, processes, and outcomes (Donabedian, 1988). This study will focus on the processes of care measures, which is seldom studied in this branch of health service research. Processes of care can be explained as how care is delivered to a patient in the hospital. Examples of process measures are whether a patient received proper medication when showing symptoms of heart attack or a stroke or timeliness of care (arrival to departure wait times). Such processes can suffer when financial resources become strained. Poor financial performance can lead to cutbacks in staffing or lack of investment in proper staff education of best practices; all of which can lead to poor quality of care. This study will be the first to use such a process measure to examine how changes in financial performance impact quality of care.

Another contribution is through the examination of how rural hospitals' quality of care is impacted by policies that significantly affect financial performance. Lindrooth et al. finds that

rural hospitals were the most impacted financially be Medicaid expansion (Lindrooth et al., 2018). While expanding Medicaid has shown to slow down the rate in which hospitals close, thereby stabilizing access to care, there is no research that finds if how quality of care is impacted by changes in financial performance among rural hospitals.

Both above are not only significant contributions to field of health services research, but they are also of value to policy makers and hospital administrators. It is important to analyze how policies like insurance expansions not only impact access to care, which is a common and important theme, but also the quality of care being delivered. This paper further examines how policies leading to financial success can improve quality of care. Administrators and health leaders in the private sector can benefit from this research as well as it provides insight into the operational impacts that a significant financial change can bring.

Remaining Chapters

This chapter summarizes the purpose and contributions of this dissertation. Chapter two will summarize and review the literature surrounding hospital quality and financial performance and identify gaps this dissertation will help address. Chapter three builds a conceptual framework identifying the relationship between hospital quality of care and financial performance. This framework is based on predominant economic theories of healthcare organizations as well as findings from prior research. Chapter four outlines the data and methods used in answering the research questions above, and chapter five will be a discussion of the results, limitations of the study, and areas of future research.

Chapter 2: Literature Review

While there is a growing body of work examining the relationship between hospital financial performance and quality of care, most of the existing studies do not use causal methodologies. To get to questions of causation, one must examine experimental perturbations in the financial performance of hospitals. One such "natural experiment" has been the expansion of Medicaid. The first section of this review will summarize the literature that assesses the effects of Medicaid expansions on hospital financial performance. The second section of this review will focus on literature examining the relationship between hospital financial performance and quality of care. The final section of this chapter will then assess the state of the current literature and the gaps that exist as well as the methods that can be used to help alleviate the endogenous relationship between hospital finances and quality of care.

Medicaid Expansion and Hospital Finances

A major provision in the ACA was the expansion of state administered Medicaid programs. A primary goal of this legislation was to expand insurance coverage to previously uninsured individuals. Under this law the federal government would match up to 90% of states' spending on expanded Medicaid to accomplish this goal. Several studies have examined the impact of Medicaid expansion on hospital finances, noting that the major mechanisms by which expansion impacts hospital finances (Blavin, 2016; Camilleri & Diebold, 2019; David Dranove et al., 2016). First, expansion increases insurance coverage for a population that previously had little or no coverage. This is beneficial for hospitals and health systems because patients who were unable to pay before now have a type of payment for services rendered. While Medicaid historically doesn't pay the same rates as other payers; like Medicare and commercial payers, new Medicaid payments exceed what these patients could pay before (White & Whaley, 2019). This improves revenue for the hospital through decreases in uncompensated care costs for the

newly insured and through increases in demand for medical services. Uncompensated care costs are defined as costs incurred for treating patients and not receiving payment. This is usually categorized as charity care or bad debt. Research has also established that increases in insurance coverage lead to a higher amount of utilization, other things constant (Baicker & Finkelstein, 2011; Manning et al., 1987; Mazurenko, Balio, Agarwal, Carroll, & Menachemi, 2018). This utilization effect differs from the revenue effect discussed above in that the expansion of insurance leads individuals to utilize more medical services, which will generally lead to increased revenue.

Blavin offers one of the most comprehensive studies to date that examines the impact of Medicaid expansion on uncompensated care, Medicaid revenue, operating margins, and excess margins (Blavin, 2016). He uses a difference in differences regression to find that hospitals in expansion states benefitted from the policy change. Accounting for trends existing before Medicaid expansion, Blavin found that hospitals in expansion states experienced experienced a 2.5% increase in Medicaid revenue, a 1.1% increase in excess margin, and 1.2% decrease in uncompensated care costs relative to expected non-expansion financial measures. All of these differences were statistically significant. The financial measures are derived from the Medicare Cost Reports that hospitals are required to submit to CMS. Hospital size (number of beds), organizational structure (for profit, non-profit, government), geographic area (urban, metro, or micro), and system affiliation, and county unemployment rate are used as control variables. These controls are used to account for inherent differences that may exist between hospitals that could impact financial standing, regardless of expansion status. He further extends his work to focus on states with high vs. low uninsured rates. High uninsured states are those with an uninsured rate above the national median, whereas low uninsured states are those with an

uninsured rate below the national median. The findings show that hospitals in states with higher uninsured rates realized a 2.2% decrease in uncompensated care costs as a percentage of total expenses compared to a 1.6% decrease in states with higher insured rates.

This finding is consistent with expectations as states with inherently higher uninsured rates have more "low hanging fruit" and will benefit most from insurance expansion. Dranove and colleagues find similar results in their analysis of Medicaid expansion and hospital financial performance (David Dranove et al., 2016). Using a similar methodological approach as Blavin, they find that hospitals in expansion states decrease their uncompensated care costs as a portion of operational costs from 4.1% to 3.1%. They also apply their findings to estimate states not expanding coverage would have seen a decrease from 5.7% to 4.0% in uncompensated care costs as a percentage of operational costs.

The difference in pre-expansion uncompensated care costs between expansion and non-expansion states raises concerns that there could be other factors between states in the control and intervention group that cause these rates to vary. For this reason, it is especially important to test the validity of the natural experiment of Medicaid expansion by evaluating the pre-trends in quality of care between expansion and non-expansion states. One of the key assumptions of a difference in difference estimation (which is utilized in this dissertation) is that the pre-intervention trends are similar between the two comparison groups. This will be tested and discussed later in the dissertation to determine if financial shocks caused by Medicaid expansion can act as a true exogenous shock to hospital quality. In addition, differences-in-differences cannot address factors that occur after the intervention and have differential impacts on treatment and control hospitals. Robustness checks with alternative control variable specifications can be used to provide evidence suggesting whether time-variant factors are a concern.

Another valuable addition their research brings to the literature is it tests the theory that states with inherently higher uninsured rates will be the ones most impacted by expansion (i.e., states with higher uninsured rates will see greater decreases in uncompensated care costs). They proxy uninsured rates by taking the share of childless adults in a Hospital Service Area (HSA) since this group will be the ones most likely to be impacted by Medicaid expansion because most Medicaid benefit designs across all states excluded adults without children (David Dranove et al., 2016). Hospitals in expansion states with a high proportion of childless adults experienced a 1.6% decrease in uncompensated costs in comparison to 0.4% decrease among those areas with a lower proportion of childless adults. These findings confirm that those hospitals in areas with populations gaining the most coverage see greater financial benefit from Medicaid expansion. These findings show that Medicaid expansion was a financial benefit for hospitals in expansion states. These hospitals had better margins and decreased uncompensated care costs in comparison to non-expansion states over the same period.

Hospital Finances and Their Impact on Quality of Care

The emergence of literature examining the interaction between hospital financial performance and quality of care has been somewhat sparse in comparison to other topics within health services research. However, in recent years more research has investigated this relationship due to increased financial pressure and a greater focus on quality of care in healthcare delivery systems. Even with the emergence of new research, gaps in knowledge remain because very few studies use methodological approaches that account for the endogenous relationship between hospital finances and quality of care. The purpose of this dissertation is to address this endogeneity and be one of the first studies to use methodological techniques to mitigate this endogenous relationship by using Medicaid expansion as an identification strategy

to determine the impact of hospital finances on quality of care. This section reviews the relevant literature examining the relationship between financial performance and quality of care.

The association between quality of care and financial performance began to be examined in the early 1990s (Cleverley & Harvey, 1992; Harkey & Vraciu, 1992; Nelson et al., 1992). The primary contribution of these studies was to lay the theoretical foundation for the relationship between healthcare quality and hospital financial performance. These studies acknowledge the complex, circular relationship between financial performance and quality of care, but do not use empirical methodologies to mitigate biases. Comprehensive panel data was not readily available at the time that these studies were conducted, so simple cross-sectional analyses using correlations, linear regression, and association analyses were used.

These studies established an association between high quality of care and strong financial performance, but the authors were not able to establish a causal relationship between those two variables. The main outcome variables used in these analyses were profit margin and return assets. These were selected because they are the most highly recognized measures of profitability in the private sector, and they are relatively straightforward to calculate. The presence of unmitigated endogeneity via reverse causation serves as the key drawback of these studies, however. Specifically, every study examined assumes that financial performance affects quality during one point in time. But the issue with this assumption is that quality of care may also impact financial performance, thus leading to an issue of reverse causation. This problem introduces bias into the reported results above and calls into question whether the results accurately represent the true relationship between quality of care and financial performance.

A multitude of studies have since been published that examine this relationship in hospitals (Bazzoli, Chen, Zhao, & Lindrooth, 2008; Bazzoli et al., 2007; Dong, 2015; Encinosa & Bernard, 2005; Everhart, Neff, Al-Amin, Nogle, & Weech-Maldonado, 2013) Four of these studies use panel data, but only three use econometric methods to account for the feedback loop between quality and financial performance, thus separating them from the rest of the literature (Dong, 2015 and Bazzoli et al., 2008,). Results from these methodologically more rigorous studies are mixed.

Bazzoli et al. (2008) no evidence of a relationship between financial performance and quality. They account for this feedback loop by implementing a generalized method of moments framework. This technique uses the lags and differences of the variables used in the estimating equation to act as instruments to mitigate the endogeneity that inherently exists from the framework outlined. By controlling for these issues (to some extent) they find that hospitals that performed below the 25th percentile in financial performance (operating margin) did *not* have significantly higher rates of mortality or surgically related adverse events in comparison to hospitals above the 75th percentile (Bazzoli et al., 2008).

One explanation offered for these results is that operating margin may not perfectly measure hospital financial performance. While hospitals must have a positive operating margin in the long run, they may be able to use other sources of funds to improve patient quality of care (Bazzoli et al., 2008). Donations, changes in tax laws, and investment income are just a few of the potential sources of funds used by poor performing hospitals to compensate for financial shortcomings. These types of outside sources are especially beneficial for non-profit hospitals. Approximately 85 percent of the hospitals in this study were non-profit, warranting caution as operating margin may not always be the best indicator of financial performance.

The second paper examines how financial management affects process of care measures for patients with cardiovascular disease (Dong, 2015). Using data from the Hospital Compare database, the author constructs a composite quality metric based upon process scores for patients being admitted with cardiovascular disease. Examples of these measures include patients receiving aspirin upon arrival, patients given a beta blocker at discharge, and heart attack patients given smoking cessation counseling (Dong, 2015). The analysis uses lagged financial values along with state and hospital level fixed effects to determine how financial performance affects process quality outcomes. Fixed effects help control for unique hospital level characteristics that may be hard to measure or unobserved. Lags help address the endogoneous relationship between hospital quality and financial performance by looking at prior values of financial performance and how the impact current levels of quality. Hospitals that were not public and had higher levels of total assets had better quality outcomes. However, key financial and operating metrics like profit margin, financial leverage, and age of hospital were not found to have a statistically significant impact on quality. Another important finding from this study was that hospitals that had higher levels of salary to revenue ratios (e.g. hospitals that pay their employees more) had higher levels of quality (Dong, 2015). Unlike the results found in Bazzoli et al., this study supports the hypothesis that better financial position improves quality of care, but results are inconsistent across financial performance measures.

The use of panel data is superior to that of cross sectional data to account for reverse causation. One advantage of panel data is that it allows researchers to see how changes in variables through time affect the outcomes being measured. However, one must consider other underlying factors and trends when interpreting the results from these studies that use panel data. One such example is that of a hospital (or health system) that has had strong financial

performance and/or high quality outcomes for the entirety of the panel being examined. It is likely to be true that some hospitals may not have drastic changes in quality of care or financial performance from year to year. Without this variation, then no statistically significant results may be found as was the case in the Bazolli et al. analysis (2008). The death rate among those in low mortality DRGs across the study period (1995 to 2000) only spanned the range of 0.06 to 0.07 percent. This lack of variation across all years likely led to the statistically insignificant results regarding the impact of operating margin on quality of care.

The key weakness of these two studies is that they can only marginally control for selection bias. Selection bias undermines the results a study because the determination of control and intervention groups isn't random. Take for example a smoking cessation program where participants can choose, or select, to participate in the study. The final results may be biased since those individuals choosing to be in the program (participate in the intervention) are likely to be more committed to quitting smoking than someone who was randomly selected to participate in the program. The end results will not likely be a true representation of the effectiveness of the program since the underlying participants don't represent the average smoker. The existing literature around hospital financial performance and quality of care is also suspect to this bias in that no true control and intervention groups exists. By only evaluating hospitals in one state, those that inherently perform better will likely by more able to respond to changes in financial status in comparison to those hospitals without vast financial resources. Thus, comparing pre and post change in quality of care without a true control group can allow final estimates of financial performance on quality of care to be biased.

Both studies rely upon claims data, which is a methodologically comprehensive way to measure changes in outcomes over time, however, there is no control group of hospitals to

account for trends in healthcare utilization, changes in health policy, and macroeconomic factors. My study builds upon this literature by addressing this limitation utilizing a difference in difference framework with delineable control and intervention groups. The work done by Bazzoli et al. (2008) and Dong (2015) did not have such groups, instead they selected a particular period of time and partially controlled for selection bias by accounting for inherent hospital characteristics that could have impacted quality of care. A strength of a difference in differences approach is that omitted variables are differenced out between control and intervention groups (hospitals in respective states), assuming that these omitted variables are the same across states. This is a crucial point because there can potentially be variables that are omitted from the analysis that impact financial performance, quality of care, or both.

Omitted variable bias is a situation where there are key variables excluded from an analysis that impact the outcome being examined. A classic example presented by Angrist and Pischke is the impact of education and ability on wages. However, if a person's ability is excluded from the model, the estimated impact of education on wages is likely inflated because the impact of ability on wages ends up being "collected" by the estimated coefficient for education. Specific to this study, a possible omitted variable could be hospital leadership. Stronger and more influential hospital leadership can positively impact quality of care or be inherently different (better or worse) in states that expanded Medicaid, generally speaking. If these variables are not included in the regression framework then the estimated impact of a hospital experiencing a positive financial shock through Medicaid expansion can be inflated. This is a threat to the results and internal validity of this study because the final estimate will be biased. Partially accounting for these omitted variables can be accomplished econometrically and will be discussed in further detail in the methodology section of this dissertation.

Although these studies offer much stronger evidence and rigor regarding the relationship between quality and hospital financial performance, several limitations are worth noting. Bazzoli et al. uses hospital mortality in "low death DRGs" as a quality indicator (outcome measure) to assess if a hospital is providing adequate care for patients whose care is deemed to be more easily controlled by the hospital (2008). While this measure is suitable for the analysis they conducted, they were not able to fully control for the inherent variation in risk among the patients treated in each hospital. Such risk adjustment would have produced more accurate results because the risk levels in patients not only differ within facilities but also between states. Since their analysis examined 11 total states, not effectively controlling for patient health status could bias the quality metrics that were being evaluated.

The most recent contribution to the literature in this area is highly aligned with the methodological approach featured in this dissertation in that it uses Medicaid expansion as a natural experiment, and its exogenous financial shock as a source of variation (Camilleri & Diebold, 2019). They use 10 measures patient satisfaction to examine if the change in hospital finances in expansion states positively impacted those scores. Three of these measures were found to change significantly: nurse communication, physician communication, and room quietness. Examining patient satisfaction scores was a contribution to the literature as there have been a limited number of studies on examining quality of care as measured by patient satisfaction.

My study will build upon this research and fill in some of the remaining gaps in this literature. First, my dissertation will examine a process-based quality of care measure. To date, research in this area has focused on outcomes-based quality measures or patient satisfaction scores. This new contribution is important because understanding how financial changes impact

all aspects of care delivery should be considered when implementing and creating a new policy. It is also useful for hospital managers and administrators as they can potentially have a better idea as to how a specific policy impacts their day to day operations. These day to day operations are crucial for care delivery because these types of processes serve as inputs to the often studied and emphasized outcome measures like mortality and readmissions.

Another difference is that Camilleri and Diebold use an instrumental variables approach in their regression analysis to account for the changes in financial performance. In stage one, they estimate the change in uncompensated care using a difference in difference regression. Using that output, they run the second stage regression using the estimated uncompensated care model in their primary model to examine the impact of financial performance on quality of care. My analysis will differ because I am using a more traditional approach using a difference in differences methodology without the use of an instrumental variable. This is beneficial for two reasons. First, this method examines more than how a decrease in uncompensated care costs impacts quality since it is also able to account for the increases in demand and service utilization brought about by Medicaid expansion. Second, I can test whether a financial shock caused by Medicaid expansion is the *only* factor causing changes in quality of care. This is a broader methodological falsification test that examines if the financial shock caused by Medicaid can be used as a true exogenous shock in studies like this. This falsification test is especially beneficial as it ultimately determines if the financial shock is the key driver of changes in quality of care; which is at the heart of this analysis and the aforementioned study.

These most recent studies suggest that exogenous financial shocks did not have significant impacts on all aspects of mortality or patient satisfaction, but gaps and weaknesses still exist in the literature. First, the relevance of this literature in today's delivery landscape is

somewhat limited. The BBA was legislation passed in 1997, so any new shocks to hospital finances, especially those policy related, may have considerably different impacts on quality of care. Updated research is needed to investigate how external shocks to financial performance in today's environment impact quality of care.. One such gap is created by the reliance almost entirely on outcome measures of quality cited above—mortality and patient satisfaction. This study instead assesses changes in quality using process of care measures. Additional research is needed because quality of care has the potential to be impacted *or* not impacted at all. Quality of care could increase with the better financial position brought about by Medicaid expansion, which could allow these hospitals to invest in staffing or newer capital. However, technological advances in quality systems and delivery methodology since the BBA could make it possible that hospitals wouldn't experience declines in quality even after making significant operational changes.

Other limitations of the literature pertain to the populations studied and the outcomes and conditions used to measure quality. Bazzoli et al. (2008) and Dong (2015) focused on individual states where researchers had access to claims data, which limits generalizability. Thirty-day mortality was the primary outcome measure for these studies, with AMI being a condition to which much attention is given. Seshamani et al. (2006) call such measures as "high profile" metrics that hospitals may spend additional resources and time on ensuring that such measures do not fall below acceptable standards.

A final limitation of the literature is the lack of control and intervention groups in almost all studies. One study examines how a New Jersey law decreasing state based uncompensated care aid to hospitals impacted quality in comparison to hospitals in New York; the control group (Volpp, Ketcham, Epstein, & Williams, 2005). There were no significant differences found in

overall 30-day mortality, but uninsured patients experience increased rates of AMI related mortality. While this study did use a control group, it exhibits some of the drawbacks mentioned earlier: a small geographic region of analysis and mortality-based outcomes. It is important to note that there is a large body of literature surrounding policy changes causing adverse financial pressure and their impacts on quality of care. While many strong theoretical arguments and foundations have been developed, more empirical research is needed to address methodological weaknesses, limited measures of quality, and concerns with generalizability.

Chapter 3: Conceptual Framework

Hospital quality of care has implications for healthcare costs and health outcomes. Quality of care is a is product of many factors including processes, environment, and resources. . Financial resources are some of the most important for a hospital as it funds day to day operations as well as long term capital projects. Understanding the relationship between financial resources and quality of care can be complex as both are closely intertwined. At a theoretical level the foundations of the relationship between resources in general, and financial resources in particular, have been discussed in the literature over many decades. This section will synthesize the theoretical relationships discussed in the literature and apply those to the core question at hand: how do changes in hospital financial status impact hospital quality of care.

Quality of care has been extensively studied and analyzed in the literature over the past three decades. One of the most widely cited studies is by Donabedian (1988) which breaks downs quality into three major domains: structures, processes, and outcomes. Each of these domains can be thought of as ways to measure quality and to assess how care is delivered in various settings. Structural components of quality refer to the labor, capital (facilities, equipment, etc.), or other resources used to produce services. Process measures of quality are best described as *how* care is delivered and if clinically proven methods are followed during treatment. Outcome measures examine the results of patients after receiving treatment in a hospital or other healthcare setting. Examples of outcome measures include readmissions, mortality, and rates of infection for certain procedures.

The conceptual model used for this paper is partially based on the work conducted by Newhouse (Newhouse, 1970) of not for profit institutions' decisions regarding production. He outlines that hospitals, specifically non-profits, don't maximize profit given their structure, but attempt to maximize "prestige". This is primarily accomplished through maximizing quality of

care as this in a key contributor in how a hospital is viewed by a community or among its peers. In addition to quality, the quantity of services is maximized given various constraints faced by the hospital as well. This work is extended to cover for-profit institutions by Sloan (2000) to specify that hospitals maximize their utility based upon profit, output, and quality of care.

Bazzoli et al. use this framework to further describe how quality of care and financial performance are intertwined (2008). The conceptual model (Figure 3.1) used in this work is a modified version of the Bazzoli et al. model. This model includes consideration of the relationship between hospital quality of care and financial performance and is the foundation of this dissertation.

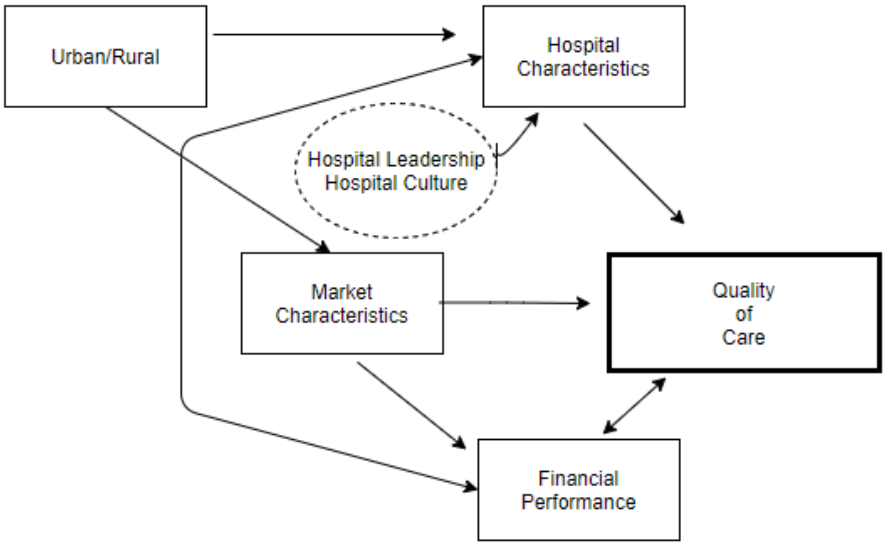

Figure 3.1: Conceptual Framework

Financial Performance and Quality of Care

This model shows that financial performance and quality are endogenously related. First, hospital quality of care is impacted by financial performance through several avenues. Hospitals facing tumultuous financial conditions may make decisions to reduce staffing, reduce training and investment in their labor force, or not make needed investments in capital. Research has found that such decisions can have adverse impacts on quality of care (Needleman, Buerhaus, Mattke, Stewart, & Zelevinsky, 2002; Stanton & Rutherford, 2004). It is important to note that financial performance doesn't necessarily impact the quality of care delivered in the hospital instantaneously, as mentioned above. Profitable or unprofitable performance in the short run (month or quarter, for example) may not directly impact the quality of care delivered since clinicians are generally insulated from the impacts of those changes in that time frame. Instead,

financial performance in the short run will impact future investment decisions in quality, which will ultimately impact patient quality of care.

Table 3.1: Conceptual Framework Variables

	Concept Measured	**Variable/Proxy**
Market Characteristics		
	Financial Access to Care	Unemployment Rate, Household Income
Hospital Characteristics		
	Reimbursement Structure	Hospital Ownership Type, % Medicare Discharges, Urban/Rural
	Patient Acuity	Case Mix Index, % White
	Hospital Safety Culture	Unobserved
	Leadership	Unobserved
	Ability to Use Financial Resources Efficiently	Unobserved

The model also specifies that patient quality of care will impact financial performance. Like the framework described by Newhouse (1970), hospitals will attempt to maximize quality to increase market share (utilization at the hospital). This is achieved through reputation effects that will attract patients as well as motivate providers to refer their patients to hospitals with greater quality (Newhouse, 1970). This increase in market share results in a larger revenue stream which will likely improve overall hospital financial performance, other things constant. Mitigating this endogenous relationship requires a methodological approach that addresses the circular relationship between finances and quality of care.

Another important moderating factor that influences how financial performance impacts quality of care is an implementation lag. While hospitals in expansion states experienced improved financial position, the speed in which these financial gains trickle down and impact

quality of care can vary. This is of particular interest for this study since expansion state hospitals realized improved financial performance after expansion. Hospitals with acceptable quality of care may not have invested these additional resources in quality improvement initiatives or could have reallocated resources to areas with a more pressing need. This timing effect is somewhat different than the example above in that it is primarily related to the decisions made by the hospital as to where resources should be invested. The magnitude of this moderating factor is also ambiguous. For example, a hospital with vast financial resources may not be impacted by either great increases or decreases in financial standing. If some event occurs that deteriorates financial standing, this hospital will likely have enough in reserves to maintain current operations for some period. Conversely, since the hospital is in good financial standing, greater increases in financial strength may have minimal impact on quality of care since that hospital may already be dedicating high levels of resources to its quality initiatives.

Market Characteristics

Market characteristics also impact both hospital financial performance and quality of care in several ways, one of which is through financial access to care—do patients have the financial means through income or insurance to seek care. In contrast, non-financial access considerations include availability of transportation, sick leave, or child or adult (day)care, among others. Financial access to services is influenced by unemployment, household income, and the geographic location where the hospital is located. Areas with high unemployment or low income may have individuals with poorer health. This can occur for several reasons. First, individuals who are unemployed will find it harder to gain insurance coverage. Without insurance coverage individuals may not have the ability to receive basic health services and preventive care, which directly impacts their health. Employment also offers individuals financial resources and the

ability to have housing, food, and security; all of which directly impacts individual health (Foundation, 2013). The majority of Americans are covered through employer-based health insurance, so the loss or lack of employment eliminates this avenue of coverage. Research has also found this to be the case as it was estimated that approximately nine million individuals lost health insurance coverage as a result of the great recession in 2008 and 2009 due to job loss, and that individuals cut back on routine medical services as a result (Cawley, Moriya, & Simon, 2015).

Insurance coverage plays a crucial role in this relationship not only through health status, but also through its influence on the financial strength of the hospital. Insurance allows hospitals to be reimbursed for the services they provide. Payer mix is an important consideration in this regard as well. Commercial plans, like those offered by employers, reimburse at higher rates than Medicare and Medicaid and are often more financially attractive for hospitals. However, any payment type, even those that don't fully cover the costs of delivering care, are preferred over non-payment. Medicaid has historically fallen in this category as it covers approximately 90 cents for every dollar spent by hospitals (AHA, 2016). The expansion of Medicaid has been found to impact Medicaid related revenue among rural hospitals at a greater magnitude than their urban counterparts (Kaufman et al., 2016). Using the example above of unemployment; areas with higher unemployment experience adverse economic conditions like lower income and low insurance rates, which negatively impact hospital financial performance. Accounting for these market factors in the conceptual model is important because of the linkage that exists between health insurance and healthcare utilization (Meara, Richards, & Cutler, 2008; C. Ryan & Bauman, 2016).

Hospital Characteristics

Hospital characteristics impact quality of care as they can ultimately determine the level of quality provided at the hospital. Similar to the discussion above, the overall reimbursement structure of the hospital will impact hospital financial performance and quality of care. Hospital ownership plays a major role in this. Horwitz finds that for-profit hospitals, and non-profits to a lesser degree, focus on offering profitable services in comparison to public or government hospitals (2005). Accounting for this discrepancy based upon ownership type is necessary since some hospitals likely make explicit decisions in the types of services they offer. Geographic location (urban vs. rural) is also closely aligned to this since rural hospitals are less likely to offer high profit services due to decreased demand stemming from a smaller service area and population (Horwitz, 2005). A final measure of reimbursement structure that I account for is the percentage of hospital discharges paid for by Medicare. Hospitals with higher rates of Medicare discharges may not perform as well versus others that have a higher proportion of privately insured discharges since private plans pay higher reimbursement rates (White & Whaley, 2019). On average, private payers pay 230% of Medicare prices on services..

Patient acuity also plays in important role in quality of care as those hospitals treating individuals with a higher acuity may not perform as well on quality scores as their approach to treatment may require more resources. Acuity also accounts for the potential resources needed to treat patients in the hospital. The effect of acuity on financial performance and quality or care is somewhat ambiguous since sicker patients may have worse outcomes, however, hospitals with higher average acuity may attract more acute cases because they have the reputation and resources required for those types of services, Patient acuity is measured by the hospital's Case Mix Index (CMI). This measure assesses the DRGs that hospitals treat and apply a weight to

those. Higher average CMI values indicated that more complex and/or high-risk procedures occur at the hospital.(Propper, Burgess, & Green, 2004)

While this conceptual model captures the major factors that influence hospital quality of care, it is important to highlight those factors that cannot explicitly measured. One example is the organizational culture and leadership of the hospital. A hospital's willingness to adhere to clinically accepted standards of care, in part codified in its managerial policies and procedures, cannot be directly measured but play a crucial role in the delivery of care. Provider, staff and employee characteristics are also unobserved factors that can impact quality of care.

Finding whether a patient is treated by a "good" or "bad" individual provider(s) or whether they are cared for by high-performing versus low-performing teams when they enter the hospital or during the course of their care is not accounted for.

Given this framework, it's predicted that financial shocks will be directly correlated with hospital quality of care. Spence (Spence, 1975) suggests that firms face a tradeoff between quality and financial performance which further reinforces that any decreases in financial performance will adversely affect quality of care. Specifically, within the hospital industry, Dranove and White (1998) examined how Medicaid hospitals reacted to changes (cuts) in Medicaid reimbursement using the framework outlined by Spence (1975). They find that hospitals most dependent on Medicaid as a reimbursement stream cut service level intensity (the proxied measure of quality in this study) across all payers (Commercial, Medicare, Medicaid). This is in alignment with the framework of Spence (1975) and Newhouse (1970) in that tradeoffs exist between financial performance and quality of care.

Based upon these findings, I formulate these hypotheses regarding the changes in financial performance on quality of care.

Hypothesis 1: Hospitals in states that expanded Medicaid will have improved quality of care in comparison to those in states that did not expand Medicaid. This is due to the financial boon experienced by these hospitals.

Hypothesis 2: Hospitals in rural areas will see larger magnitudes of change in quality of care due to the greater increase in Medicaid revenue brought about by Medicaid expansion.

Chapter 4: Methodology

The empirical specification of the conceptual framework and research questions discussed in the previous chapters will be discussed in this chapter. This chapter will cover the data used for this study, statistical methods, econometric considerations, variable selection and caveats, and the methodological contribution of this study to the literature.

Research Design

This study examines the impacts of changes in hospital financial performance on hospital quality of care. I will use Medicaid expansion under the ACA as a natural experiment to see how quality of care was impacted by the increases in revenue brought about from the policy. This revenue increase is brought about in two ways. First, the increased volume that is generated by an insurance expansion, and second, the *decrease* in unpaid or bad debt write offs. Most importantly, the expansion allows for the use of control and intervention groups since some states elected to not expand Medicaid coverage. Building on established evidence that Medicaid expansion positively impacted hospitals in expansion states, I use a difference in difference regression to show how changes in financial standing impacts quality of care.

Study Sample

Data spanning from 2013 to 2015 is used in the regression models. The pre period is represented by the year 2013 while the post period is represented by the year 2015. The year 2014 is excluded from the analysis since most states that expanded Medicaid were implementing the expansion during that period. Several states are excluded from the analysis because they had Medicaid programs in place that met or exceeded the eligibility thresholds set under the ACA. These states include Michigan, California, Connecticut, Minnesota, New Jersey, and Washington D.C. This is in accordance with the states excluded by Blavin (2016). Any observations that are missing for a given year are not included in the analysis, thus making this an unbalanced panel.

A total of 1,985 hospitals were included in the pre-period control group, 2,071 hospitals in the post-period control group, 893 hospitals in the pre-period treatment group, and 956 hospitals in the post-period treatment group. Variation among the pre and post intervention is caused by an increase in the number of hospitals having enough hospital discharges to warrant inclusion in the published numbers by CMS.

Data Sources

Multiple data sources are used in this study. Quality data is derived from a subset of the Hospital COMPARE database. This program was initially formed in 2002 by the Healthcare Quality Alliance (HQA) as a way for consumers to gain insight on key measures of quality of care at the hospital level (Jha, Li, Orav, & Epstein, 2005). The sets of measures have evolved since that time, but in general measures include rates of infection, mortality, readmissions, patient satisfaction, and adherence to clinically proven processes and standards when treating patients with certain conditions. Additional data for control variables comes from the Census Bureau and are reported at the county level. The linkage is based upon the county in which the hospital resides by the Federal Information Processing Standard (FIPS) geographic code. These include demographic mix, median household income, and the unemployment rate.

Rural hospital status is derived from data published by the Sheps Center for Health Services Research (Center, 2016). Each hospital in the dataset has a rural-urban commuting area (RUCA) code that classifies the degree in which a hospital is more urban or more rural. These codes separate hospitals based upon their population size and percentage of population flow to larger urban areas. Hospitals with a RUCA value greater than three are considered rural. Hospital level controls like number of beds, Medicare share of days, and hospital ownership status comes from general CMS hospital information.

Variable Measurement

Dependent Variables

Two broad categories of dependent variables will be used to assess hospital quality of care. First, the measure of process-oriented care is the share of patients receiving who received Venous Thromboembolism (VTE) prophylaxis on the day or day after their initial hospital admission. This is a preventive measure undertaken by hospitals to help reduce the percentage of patients having major blood clots. This measure is published by CMS in the hospital COMPARE dataset. These data are publicly available and are used in part to determine a hospitals' reimbursement from Medicare. The eligible patient population includes all patients 18 years or older who had a hospital stay longer than two days. There are several exclusion criteria including patient being admitted for mental health or stroke diagnoses. A primary focus and contribution of this dissertation is the use of process of care measures rather than the outcomes of care measures commonly used in previous research. Processes of care are essential to understand the "root cause" of potential quality or safety issues in hospitals (Burton, 2016). Processes ultimately translate into outcomes because the day to day work conducted by hospital staff will in part impact outcome measures like readmissions and mortality. Process measures are also advantageous from a process improvement standpoint because they pinpoint specific behaviors that can be improved, which is not a characteristic of outcomes-based measures (Rubin, Pronovost, & Diette, 2001). Measuring how hospital processes are impacted by financial changes is essential because it can help policy makers and hospital administration aware of how clinically proven best practices are impacted when financial shortages or surpluses exist.

Similar to many previous studies, this work will also examine the impact of hospital financial performance on the second major category of quality of care, clinical outcomes. As

noted above, outcomes measures have been extensively studied throughout the literature as they focus on patient outcomes, the all-encompassing measure of the result of any hospital stay. The particular outcomes-based quality measure is 30-day mortality rates for Acute Myocardial Infarction (AMI). These data are also derived from the COMPARE data set, but unlike the process of care measures which examine one year in time, these measures cover a three-year timeframe. The pre-intervention period spans from July 2011 to June 2014 while the post period spans from April 2015 to March 2018. A potential advantage of the larger measurement windows is the ability to see how hospitals are impacted years after expansion. As has be noted, changes in financial conditions may not have an immediate effect on quality of care, so a longer window of time may allow for a more accurate representation that financial performance has on quality.

Both sets of measures are risk adjusted based upon patient characteristics like age, acuity, presence of comorbidities, and medical history. This is advantageous since additional risk adjustment is not required and it allows for the analysis to compare rates across hospitals, regardless of the type of patients they are treating. Some hospitals are excluded (data not reported by CMS) from one or both of the broad categories above due to a limited sample size of the events at hand. A total of 2,807 hospitals were in the pre period and 3,027 were in the post period.

Control Variables

Several variables will be used to control for the inherent differences that exist between hospitals. The first broad category of control variables are those representing hospital characteristics. Measures include size of the hospital, rural or urban location, ownership type, and patient mix. Total number of beds are used as a proxy for the size of the hospital. Hospital

ownership can take on one of three values: public/government owned, non-profit, or for-profit/private. Rural and urban classification is based on the rural-urban communing area (RUCA) classification. This system is used by the Census Bureau to measure population density and daily commuting across all census tracts. Patient mix is measured by taking the total number of days utilized by Medicare patients divided by all patient days. These data are derived from the CMS Inpatient Prospective Payment System (IPPS).

The second category of variables are those that measure market characteristics of the hospital. Market characteristics help control for the economic environment of where the hospital is located as well as other demographic differences. The unemployment rate and the median household income are used as the primary market control variables. These are measured at the county level. Following the work of Camilleri and Diebold (2019), the percentage of white residents at the county level is used to help control for the demographic composition of the hospital market (2019). The table below summarized the variables and data sources used in this study

Table 4.1: Variables and Data Sources

Variable	Data Source	Description
Dependent Variable		
Share of patients receiving VTE	Medicare COMPARE	Process of Care Measures
30-day mortality rate	Medicare COMPARE	Outcome Measure
Hospital Characteristics		
% Medicare Days	CMS IPPS	This is a proxy to account for the number people who are covered by private insurance
Hospital Ownership	CMS Hospital Information	
Rural/Urban Classification	UNC Sheps Center	
Number of Beds	CMS Hospital Information	
Market Characteristics (county level)		
Median Household Income	Census Bureau	This is used as a proxy for local economic conditions
Unemployment Rate	Census Bureau	This is used as a proxy for local economic conditions.
% of White Residents	Census Bureau	This is used as a proxy for local market conditions regarding utilization and economic conditions.

Empirical Specification

Using the theoretical framework outlined in chapter 3, this section will detail the regression approach taken and the various models examined along with an explanation of the findings. Three broad areas of analysis will be discussed with the first being the impact of financial changes on process of care measures, the second on how these changes impact outcome measures, and the third on how rural hospitals have been impacted.

Process of Care Model

A difference in difference model will be used as the primary causal identification method in this dissertation. This quasi-experimental approach is advantageous because it accounts for

common changes that may occur within the groups over time. This approach can also help control for the omitted variable bias discussed in the literature view. Let's say that the change in quality in an intervention state is represented by

$$\beta_{intervention\_state} = quality\ (after\ intervention) - quality\ (before\ intervention) + omitted\ variables \quad (1)$$

and change in quality in the control state is

$$\beta_{control\_state} = quality\ (after\ intervention) - quality\ (before\ intervention) + omitted\ variables \quad (2)$$

To then find the impact of the intervention we would subtract the change in quality from the control state, which serves as the baseline, from the intervention state

$$\beta_{impact} = \beta_{intervention\_state} - \beta_{control\_state} \quad (3)$$

When this occurs, the omitted variables are subtracted out leaving the true estimate of the impact of the intervention, β_{impact}. This is a simple example, but this illustration shows that a primary advantage of a difference in differences framework. This study is contribution because it is the first to use this framework and have the accessibility of control and intervention groups to examine the impact of changes in hospital financial performance on quality of care.

The reduced form model shown for this analysis is shown in (4)

$$Quality\ of\ Care = B_0 + B_1(Expansion\ State) + B_2(After\ 2015/Post) + B_3(Expansion*After\ 2015) + e \quad (4)$$

This reduced form model serves as the foundation of my analysis examining processes of care. This equation is related to (3) in that B_3 is measuring the impact or difference in quality of care brought about by Medicaid expansion. Quality of care is my primary outcome measure and the

focus of the study which is measured by percentage of patients receiving VTE and by AMI mortality. The *Expansion State* (B_1) variable corresponds to the intervention state variable in (2) and is a dummy variable that indicates if a state expanded Medicaid or beginning in 2014. The *After 2015/Post* (B_2) variable is a dummy variable that indicates the pre/post time period. This serves as the timing variable as quality of care before and after Medicaid expansion is being examined. An interaction variable between these two variables is then created to serve as the difference in difference estimator (B_3). This variable shows the impact of the change in financial resources had on quality of care for those hospitals in states that expanded Medicaid. This estimate is the primary variable of interest in this analysis and measures the overall impact of changes in financial performance on quality of care.

This model uses the share of patients receiving VTE prophylaxis as the quality of care variable. Theoretically, the simple model *should* be the only model needed if the expansion in Medicaid is a true exogenous financial shock. This should be the case because a true financial shock isn't correlated with other variables or factors and should not be able to be predicted by such variables. A key assumption that I test is whether the estimated impact of the financial changes (B_3 in equation one) changes as I add more control variables to the reduced form model. If this estimated coefficient changes then that is a sign that the financial shock caused by Medicaid expansion is not exogenous. This is a key assumption of DD research design. A violation of this assumption means that the expansion of Medicaid is not random and that there may be variables correlated with Medicaid expansion *and* hospital quality of care. Such correlation will cause the estimated effects of the financial shock to be biased.

A key methodological assumption behind a difference in differences regression is that both the control and intervention group follow parallel trends prior to the intervention taking

place. This is important because the two groups need to exhibit similar, but not identical behavior for a causal interpretation to be applied to the intervention group. This is accomplished by either plotting the trend of the outcome variable(s) over time or running a regression to see if prior years' estimated values are statistically different? from each other. A limitation of the data used here is that the share of patients receiving VTE does not span prior to 2013, so the testing of trends can't be accomplished. To mitigate this, I will use the share of patients with acute myocardial infarction (AMI) that received aspirin at discharge as a proxy process of care measure. This process of care measure captures whether hospital staff administers aspirin, which is found to be an effective way of treating AMI (Krumholz et al., 1995). Data are available for this measure from 2010 to 2013 at the hospital level, so I will have the ability to test the parallel trends assumption.

The equation shown in (5) will add the aforementioned control variables.

$$Quality\ of\ Care = B_0 + B_1(Expansion\ State) + B_2(After\ 2015/Post) + B_3(Expansion*After\ 2015) + B_4(Hospital\ Characteristics) + B_5(Market\ Characteristics) + e \quad (5)$$

The results of the B_3 in this equation will be compared to those in Equation 3. If large differences exist between the two, then it can be concluded that there is likely bias in using Medicaid expansion as a financial shock. However, if minimal changes occur, it is likely the case that Medicaid is an exogenous shock and can be used as a natural experiment to examine its impact on hospital quality of care.

While the model specified in Equation 2 controls for characteristics at the hospital and market level, other unobservable factors can influence the quality of care delivered at hospitals. To help control for these unobserved variables, hospital level fixed effects will be used to

account for time invariant unobserved hospital characteristics that are correlated with the observed variables. This method is widely used in the literature to account for unobservable factors impacting the model. This model, as well as proceeding regressions will use robust standard errors to account for heteroskedasticity.

Outcomes Based Model

A focus and contribution of this dissertation is the use of process of care measures as stated in the previous section. However, I examine additional models using outcomes-based measures since these measures are prevalent in the existing research and the data are readily available. The same approach from the process of care measures is used to assess how outcomes are impacted by the change in hospital financial changes. 30-day mortality measures are the primary outcomes-based measures examined in the respective models.

These measures have similarities and differences that are important to highlight. Key differences are that outcome measures tend to measure the health or status of a patient upon discharge from a hospital with a condition like heart disease or pneumonia. Whereas process measures like share patients receiving VTE do not look at patient status, but primarily examine if protocols are followed. While the focus of these measures is different, process measures do ultimately influence outcomes, especially for measures where specific conditions are being treated. Processes can be thought of the inputs into quality and outcomes can be thought of the outputs.

Rural Hospital Model

Equation 3 includes rural hospitals as a control variable, but this analysis also examines them apart from non-rural hospitals as a separate analysis. Estimates of B_3 measures the *average*

effect of the financial shock on quality of care across all hospitals. However, it is likely the case that Medicaid expansion impacted rural hospitals to a greater degree than their urban counterparts. Kaufman et al., note that rural hospitals rely more on public payers like Medicaid and have inherently lower profit margins relative to urban hospitals (2016). Similarly, Lindrooth et al., found that hospitals in rural areas that expanded Medicaid were less likely to close due to the improved financial performance brought about by expansion (2018). Both analyses emphasized that rural hospitals are in unique situations because they generally serve populations that are uninsured or underinsured and they may deliver higher levels of uncompensated care.

Running a separate regression on the subset of rural hospitals is beneficial because it allows the opportunity to see if rural hospitals are impacted to a greater degree than all hospitals in the study sample. Given the evidence shown by prior research and the inherent differences that exist, it is expected that hospitals in rural areas will be impacted greater than urban hospitals because of their greater reliance on public payers like Medicaid.

Summary

This chapter has covered the basic research design of the dissertation and the variables being used. A difference in difference equation with fixed effects will be used to estimate the impact of financial changes on hospital quality of care. Three primary types of analyses are included in this dissertation. Fist, a process of care model is examined, which focuses on whether clinically proven practices are followed in care delivery. This is a major contribution to the literature because such types of measures are seldom used when assessing hospital quality of care. Shifting the focus of assessment of quality from outcomes measures to measures of process is critical as it is the process of care that actually determines the clinical outcome. Process measures can be used to identify hospital, provider, employee and even consumer behaviors that

materially affect clinical outcomes. Moreover, process measures provide the most direct insights into the variables that can be adjusted to improve care quality.. Understanding how these changes impact day to day operations of a hospital are important for policy maker, researchers, and managers because the day to day processes are ultimately inputs into overall quality of care. The second model focuses on 30-day mortality. This is a more traditional measurement of hospital quality and is analyzed to adhere to prior studies analysis of quality of care. The final model focuses on rural hospitals.

Chapter 5: Results

Four overarching models with specific dependent variables are presented: all sample process outcomes, rural only sample process outcomes, all sample outcomes measures, and rural only sample outcomes measures. The results of the testing of trends analysis and general descriptive statistics are also presented.

Testing of Trends

As discussed in the methods section and literature review, a core assumption in the difference in differences regression framework is that the control and intervention group have similar pre-treatment trends. This must be satisfied to apply a causal interpretation to the results of the analysis as we must assume that the intervention group would exhibit the same general behavior as the control group in the absence of the intervention. The primary process of care measure used in this analysis (share of eligible patients receiving VTE) does not span back prior to 2013, which is the pre-treatment period in the analysis, making it impossible to test pre-trends on this variable. To mitigate this, I use a process measure for which the data are available to test pre-trends. Specifically, trend tests are based on the percentage of patients with Acute Myocardial Infarction (AMI) given aspirin at discharge, which is available for hospitals during the pre-2013 period.

To test whether the trends follow a parallel path, a regression analysis is conducted using the following equation

$$AMI\_Share = \beta_0\,(Expansion\_State) + \beta_1\,(Year) + \beta_3\,(Expansion\_State \times Year) \qquad (6)$$

Where dummy variables are created for each year prior to 2013. This regression will measure the trends from 2010 to 2013. Table 5.1 reports the results of this regression. Results indicate that expansion states had lower AMI and that measures are lower in 2011 and 2012 than in 2013.

The p-values associated with the estimates of interest (Expansion x Year) for the years of 2011 and 2012 are not statistically significant at the $p < .05$ level, which indicates that the difference in quality of care between expansion and non-expansion states is not statistically significant in the pre-period. The interaction terms test the null hypothesis that there is no difference in trends year over year. Since these results are not statistically different from each other, the necessary assumption that control and intervention groups must have parallel trends is met.

Table 5.1: Testing of Parallel Trends

Share of Patients: AMI	Coefficient	Standard Error	T-Statistic	P-Value	95% CI
Expansion	-0.0034	0.0013	-2.51	0.012	-0.006 - -0.00075
Year					
2011	-0.0076	0.0015	-5	0	-0.010--0.00462
2012	-0.0037	0.0013	-2.87	0.004	-0.006--0.00120
Expansion x Year					
2011	-0.0011	0.0025	-0.44	0.658	-0.006-0.0039
2012	-0.0020	0.0022	-0.89	0.372	-0.0065-0.002
Intercept	0.9902	0.0008	1178.0	0	0.9885-0.99

Process of Care Model

Descriptive Statistics

Table 5.2 below shows the results of basic descriptive statistics between hospitals in expansion states versus those in states that did not expand in the pre-treatment period. There are significant differences in baseline rates of quality of care as measure by VTE share, with expansion states achieving a share of 87.4% compared to non-expansion states' share of 85.6%. The sample is almost evenly split between urban rural hospitals between the expansion and non-expansion states, which is in line with other findings (Freeman, Thompson, Howard, Randolph, & Holmes, 2015). There is no statistical difference between the two groups. The CMI is not

statistically different between the two groups as well, which indicates that these hospitals are treating patients with the same levels of diagnostic based risk. The remaining independent variables are statistically different from each other with a p-value <.05. This is an important consideration for this study because it shows that there are inherent differences between expansion and non-expansion state hospitals before the expansion of Medicaid.

Table 5.2: Pre-Period Descriptive Statistics

	Non-Expansion (N)	Expansion (N)	Non-Expansion (Average)	Expansion (Average)	Difference	Standard Error	T-Statistic	P-Value
VTE Share	1985	893	.856	.874	-.018	.007	-2.65	.008
Unemployment Rate	2550	1277	6.957	8.02	-1.063	.083	-12.8	0
Household Income	2552	1228	46955.77	50520.43	-3564.65	413.257	-8.65	0
CMI	1839	871	1.477	1.46	.017	.014	1.25	.218
Rural	2552	1283	.479	.488	-.01	.017	-.6	.565
Percent White	2550	1228	.717	.738	-.021	.007	-2.9	.004
Percent Medicare	1790	849	.448	.417	.03	.006	5.25	0

The results from the pre-period rural sample in Table 5.3 shows an even more stark difference between expansion and non-expansion states. All variables are statistically different from each other at the p<.10 level. At the p<.05 level the percent of Medicare admissions is marginally significant at p=.051 and case mix adjustment is slightly insignificant with p=0.88. These results are further contribution of what has been reported in the literature that rural hospitals in expansion and non-expansion states have inherently different characteristics and that a majority of rural hospitals reside in non-expansion states (David Dranove et al., 2016). Expansion states had a .83 percentage point higher unemployment rate in the pre-period but had a higher household income by $2,197.

Table 5.3: Rural Hospital Pre-Period Descriptive Statistics

	Non-Expansion (N)	Expansion (N)	Non-Expansion (Average)	Expansion (Average)	Difference			
VTE Share	735	316	.803	.852	-.048	.015	-3.25	.001
Unemployment Rate	1220	621	7.056	7.888	-.832	.134	-6.25	0
Household Income	1222	620	42918.55	45115.1	-2196.58	437.75	-5	0
CMI	621	256	1.233	1.261	-.028	.016	-1.7	.088
Rural	1222	627						
Percent White	1220	620	.786	.827	-.041	.009	-4.3	0
Percent Medicare	608	244	.526	.51	.016	.008	1.95	.051

Table 5.4 shows the non-regression adjusted difference in patients receiving VTE in the pre and post periods by expansion status. Interestingly hospitals in the non-expansion states experienced a *greater* increase in hospital quality of care (as measured by percentage of eligible patients receiving VTE). This difference is important because this could potentially mean that the financial shock caused by Medicaid expansion may not be truly exogenous and could be correlated with state or hospital level factors. It could also indicate that a direct linkage between hospital financial performance and quality of care does not exist; or behave as theory would indicate. While this finding contradicts the hypotheses of this dissertation, it is still important. Implications of this finding will be elaborated further in the discussion chapter of this dissertation.

Table 5.4: Pre-Post Comparison of Processes of Care

	Non-Expansion		**Expansion**	
Sample	*Pre*	*Post*	*Pre*	*Post*
Full	85.6%	92.5%	87.4%	92.8%
Rural Only	80.3%	89.4%	85.1%	92.1%
Urban Only	88.7%	94.5%	88.7%	93.2%

Regression Analysis

Table 5.5 reports the regression results for the VTE process of care measure on the full hospital sample. Specifically, the B_3 which is the variable of interest is reported in the table. This table reports results on five regression equations: an ordinary least square regression (OLS) with no control variables, an OLS regression with control variables, a fixed effects regression with no control variables, a fixed effects regression with control variables, and a fixed effects regression with control variables and fixed effects at the state level. Each of these models are used to test whether the estimated impact of Medicaid expansion changes as more control variables are added to the regression. Theoretically, if the financial shock is truly exogenous then adding additional variables will not change the estimated coefficient since the shock is not correlated with other hospital or state characteristics.

Table 5.5: Process of Care Regression Results

Estimated Impact of Financial Shock on Quality	P-Value	Control Variables	Hospital Fixed Effects	Cluster at State Level	Rural Only Sample
-0.0159	0.043				
-0.0091	0.163	X			
-0.0096	0.026		X		
-0.0070	0.107	X	X		
-0.0070	0.354	X	X	X	
-0.0209	0.199				X
-0.0223	0.132	X			X
-0.0192	0.029		X		X
-0.0219	0.015	X	X		X
-0.0219	0.092	X	X	X	X

A primary observation is the difference in the estimated impact of being in an expansion state across the five models. This suggests that the financial shock is not exogenous and that other factors are influencing processes of care are correlated with a state's decision to expand Medicaid. As the models progress from the most basic to most robust, the estimated coefficient

decreases, which suggests that the new controls and fixed effects are accounting for more of the variation between expansion and non-expansion states. By using five models that account for fixed effects and various controls, I have shown that other factors impact process of care, and that the financial shock is not entirely exogenous.

The first model reported is the most basic in nature because it does not account for hospital or state characteristics, and simply measures how quality changed after Medicaid expansion was implemented in 2014. If the financial shock was truly exogenous then the estimated coefficients would be the same across all models, but as a robustness check, I evaluate four other models to see how the estimated coefficients change. Even when using control variables and fixed effects, the result render non-statistically significant results. While this contradicts my initial hypothesis, this provides further evidence that the relationship between hospital financial performance and quality of care is a very complex relationship that can be difficult to disentangle. Interestingly, the reduced form models (models one and three) that do not use controls have statistically significant differences that indicate the *non-expansion* state hospitals improved their process of care relative to those hospitals in expansion states. However, these results are likely biased due to omitted variables and correlation between the treatment group and state/hospital unobservables as indicated by the ever-changing estimated coefficient across the five models.

Regressions are also conducted on rural only hospitals. This is elaborated on in detail earlier in the dissertation, but the primary reason for this analysis is that prior research has shown that Medicaid expansion has disproportionately impacted rural hospitals' finances (David Dranove et al., 2016; Kaufman et al., 2016; Lindrooth et al., 2018). Two reasons for this are that

rural hospitals are heavily reliant on Medicaid as a share of payer mix, and that they serve a higher proportion of uninsured or underinsured individuals.

Outcomes Model

Descriptive Statistics

To align with the previous literature, regressions were also run using an outcomes-based quality of care measure as the dependent variable. Table 5.6 shows the non-adjusted difference between expansion and non-expansion states before and after Medicaid expansion. In the pre period there was no statistical difference between AMI related mortality between the two groups. However, the post period shows a marginally significant difference in AMI mortality (p=.052), with expansion states having a .1 percentage point lower mortality rate. Mortality rates decreased in both groups of states from 2013 to 2015, with expansion states lowering their mortality rate by 9.57 percent in comparison to 9.27 percent in non-expansion states. These changes mirror the processes of care measure in that both groups experienced improvements in quality of care, with non-expansion states' experience a greater increase in quality of care.

Table 5. 6:Average 30-Day Mortality by Expansion Status and Time Period

	Non-Expansion	Expansion	P-Value
Pre-Period	14.24	14.16	0.172
Post Period	12.92	12.81	0.052

Regression Analysis

Like the approach taken with the process-based regression models, five different regressions were conducted to examine how exogenous financial shocks impact AMI related mortality. Table 5.7 reports the regression results for the full sample and the rural sample. Much like the results seen from the process of care model, the estimated coefficient is ever changing

throughout the five models, which is an indication that the financial shock may not be entirely exogenous. All values lack statistical significance which would indicate that a weak or non-existent relationship exists between hospital quality of care and financial performance or a mis-specified model. When examining the rural only panel, the results are statistically significant, however, the changing estimated coefficient likely indicates that the financial shock is not exogenous.

Table 5.7: Outcomes Based (AMI Mortality) Regression Results

Estimated Impact of Financial Shock on Quality	P-Value	Control Variables	Hospital Fixed Effects	Cluster at State Level	Rural Only Sample
-0.0234	0.774				
-0.0517	0.53	x			
-0.0260	0.719		x		
-0.0357	0.635	x	x		
-0.0357	0.706	x	x	x	
-0.2552	0.072				x
-0.3067	0.044	x			x
-0.3441	0.027		x		x
-0.3562	0.024	x	x		x
-0.3562	0.056	x	x	x	x

These results suggest that changes in hospital financial performance do not have an impact on hospital quality of care, but using Medicaid expansion as a natural experiment does not fully address methodological problems. The rural models do show statistical significance; however, the ever-changing estimate is indicative that other factors are influencing the quality of care being delivered in these facilities. It is important to note the magnitude of the estimate among the rural sample as it is 10 times greater than the full sample estimates. This is indicative of the findings in prior research that show that rural hospitals have inherently different characteristics than their urban counterparts (David Dranove et al., 2016; Lindrooth et al., 2018)

Chapter 6: Discussion

Full Sample Process of Care Model

The results from the regression analysis highlight a few important implications regarding the relationship between financial performance and quality of care. All four regression analyses; process of care on the full and rural sample, and outcomes on the full and rural sample show that adding more controls and fixed effects the models influence the estimated impact of the financial shock on hospital quality of care. This finding is of interest because this means that there are other factors influencing the quality of care being delivered, or put another way, the exogenous financial shock caused by Medicaid expansion is not truly exogenous and is correlated with state and hospital level variables. From a theoretical perspective, truly exogenous shocks are not correlated with these types variables since all hospitals will be affected the same, regardless of state, hospital, or expansion status. When this condition is satisfied, adding other controls or fixed effects will not cause the estimated impact of the financial shock to change since it is not influenced by such factors. The results suggest this is not the case.

Several explanations can be offered for why a strong relationship between hospital quality of care and financial performance was not found. First, hospitals may have had focus on improving these measures of quality of care, regardless of Medicaid expansion status. The measures used in this study are reported publicly and performing poorly in these measures can cause repercussions regarding hospital reputation (Spence, 1975). It is very possible that hospitals experience diminishing marginal returns to quality of care. That is, quality of care is potentially approaching its maximum level in smaller increments. When examining the pre-expansion values of share of VTE, there is a statistically significant difference between expansion and non-expansion states, with expansion states have inherently higher (better) share

of patients receiving VTE. Research within the quality improvement literature suggests that hospitals can face diminishing marginal returns to quality, but that the diminishing behavior does not discourage continual improvement in quality of care measures (A. M. Ryan & Blustein, 2011). The post-expansion comparison between hospitals also indicates that hospitals are approaching maximum compliance with the measure, with the average share of patients receiving VTE being 92.5% and 92.8% for non-expansion and expansion hospitals respectively.

Another explanation for the results is the timeframe. Expansion passed in 2014, but the post-expansion measurement period was 2015. While quality performance for the 2014 program year was excluded from the sample, having one year of runout time for the expansion's effects may not be sufficient. Hospitals in expansion states that experienced a positive financial shock might not realize this financial boon immediately. Along these same lines, clinicians delivering care are further insulated from the "business side" of the hospital operations and likely won't change the way in which they treat patients due to changes in external factors like decreases in bad debt, or the increase in number of patients that have a way to pay for services. This implementation lag in conjunction with the diminishing returns to quality are possible explanations for why quality of care did not have statistically significant changes in states that expanded.

Discussion of Results: Rural Hospital Process of Care Model

Similar differences were found for the rural hospital sample during the pre and post period. However, sub-group analysis did show important difference among these hospitals in relation to the full sample. Rural hospitals had lower process of care scores relative to the full sample. Table 6.1 shows the simple pre-post comparisons of the dependent variable across the full sample, rural hospitals, and urban hospitals. An interesting finding here, and a justification

for analyzing rural hospitals separately from the full sample is that rural hospitals in both the expansion and non-expansion states had greater magnitudes in improvement in quality of care. This can be partially attributed to the lower starting points for rural hospitals. However, as stated above in discussing the full sample, hospitals in non-expansion states experienced higher rates of growth, which contradicts the original hypothesis of this dissertation. This trend is shown int Table 6.1.

Table 6.1: Pre-Post Process of Care Comparisons

	Non-Expansion		**Expansion**	
Sample	*Pre*	*Post*	*Pre*	*Post*
Full	85.6%	92.5%	87.4%	92.8%
Rural Only	80.3%	89.4%	85.1%	92.1%
Urban Only	88.7%	94.5%	88.7%	93.2%

Contributing factors for these results remain the same as with the full sample, diminishing returns to quality and implementation lag (A. M. Ryan & Blustein, 2011). Another consideration that must be made when examining the implementation lag is the capital investment decisions of hospitals. Hospitals undertake new capital investment decisions for many reasons, but primarily to either replace existing capital (facilities, equipment, etc.), to expand existing services, or expand services into new areas or service lines. Such investment decisions and the impacts from these decisions are not realized until several years after program implementation or once the final decision to undertake the capital investment is made. This process can impact the estimated effects of the exogenous financial shock on quality of care since any budgetary cutbacks by hospitals will not be seen in the calendar or fiscal year data immediately following the expansion of Medicaid. Positive expansions or investment in quality would work in the same way. If hospitals decided to invest in new capital stemming from the

better financial position caused by the positive financial shock, then those impacts may not be seen until years later.

The regression results for the rural only sample does approach a statistically significant finding and exhibits less variation in the estimates of the impact the financial shock on quality of care. The reduced form model with no control variables or fixed effects shows that on average rural hospitals in expansion states experience a 2.1% reduction in quality relative to non-expansion states. As discussed above, this is because hospitals in expansion states had inherently higher levels of quality pre-Medicaid expansion and a slower rate of quality improvement during the 2013 to 2015 timeframe. The results of this model are not statistically significant; however, the more robust models are statistically significant and show that hospitals in expansion states had a 2.2% reduction in quality during the same timeframe. While this 0.1 percentage point increase (4.7%) in the estimated impact of the financial shock is different from the baseline model, this is much lower than the what was found in the full sample model (over a 200% difference). The most important finding in the rural analysis is the model with fixed effects and control variables is statistically significant (p=.015).

This finding is important even though it contradicts the theoretical relationship between hospital quality of care and financial performance. First, it highlights that other unobserved variables factors could be influencing quality of care other than financial performance. The implementation lag and diminishing returns to quality help explain this in part, but another related consideration could be the decision framework a hospital uses when experiencing improved or declining financial performance. Assuming hospitals maximize quality of care given their various constraints, hospitals may decrease funding in other areas of the hospital or health system to ensure a high-level quality of care. As discussed in the theoretical framework, this core

argument was put forth by Newhouse (1970) and further elaborated by Sloan (2000). Since hospital quality of care is a primary driver of hospital reputation and success, hospitals may insulate programs influencing quality of care as much as possible in the face of negative financial shocks. Similarly, if the assumption that hospitals maximize their quality of care given financial and other restraints, major increases in quality improvement initiatives may not be necessary to maintain current or marginally higher levels of quality.

Discussion of Results: Outcomes Based Model

The outcomes-based model offered somewhat similar results to the process of care model, but a much more significant change was observed among rural hospitals. The primary outcome measure was AMI mortality, which was measured over three-year time periods before and after the intervention. A key advantage of this measure is that it helps mitigate the implementation lag since mortality is observed for a three-year period following Medicaid expansion. This should allow for sufficient time to pass for the downstream effects of the financial shock to take place across all the hospitals in the sample.

The full sample model saw drastic swings in the estimated coefficient across different specifications. This closely aligns with the results of the process of care model. All estimated values are not statistically significant at the $p<.05$ level, thus indicating potentially omitted variable bias in the model as well as a very weak or non-existent relationship between financial performance and quality of care. T-tests show that unadjusted AMI mortality fell by over 9% among both groups in the pre and post period, and that the two groups' mortality rates were not different in a statistically significant sense in either period.

Considerations for Future Research and Study Limitations

An important finding of this dissertation is that the financial shock brought about by Medicaid expansion is not truly exogenous for the quality measures considered in this study. Research should consider this finding if considering the shock as a natural. As stated previously, reasons for the lack of exogeneity can be partially explained by the inherent differences among hospitals in expansion and non-expansion states and by the increase in quality of care seen in non-expansion states; even in the face of poorer financials conditions (Blavin, 2016).

One limitation of this study is the timeframe examined. The implementation lag of the financial change may not be fully observed in the time period examined in this dissertation (one-year post Medicaid expansion). One reason for this is the lack of continuous quality data from 2013 years past 2015. Future studies may be able to examine hospital claims and/or discharge data for outcomes-based measures like readmissions as these data are normally published by CMS or private companies on a yearly basis. In doing so, the implementation lag could be mitigated, and potential results could more closely align with the core hypothesis of this dissertation: that adverse financial conditions diminish hospital quality of care. Another limitation of this study, and most studies using publicly reported quality data, is that the publicly available data and available measures are not consistent over time. These changes make it difficult to examine long periods of time, say over five years, as many of the measures change based on differences in inclusion and exclusion criteria. Other publicly reported measures like readmissions and mortality are reported on a three-year moving average. Conducting a pre-post analysis like a difference in differences regression can be difficult as one of the measure periods will span both the pre-expansion and post-expansion periods; as was the case in this dissertation. Using non-publicly available data based on discharges, claims, and/or encounters to create proxy

quality measures is one approach that can be taken to avoid the problems often seen in publicly reported data.

Another limitation of this study is that it assumes that Medicaid expansions are the same for each state. However, heterogeneity likely exists between Medicaid expansion (Rhodes, Buchmueller, Levey, & Nipkay, 2020). These differences can impact hospitals differently since states that expanded coverage to a higher proportion of individuals will see a greater demand and ability to pay for medical services. This is true of the various Medicaid expansion since some states expanded from having no Medicaid coverage to full coverage. Rhodes et al. point out that: "*states like Kentucky and West Virginia, the upper income eligibility limit for a single, childless, able-bodied adult increased from $0 to $16,105 on January 1, 2014. In New York, in contrast, Medicaid eligibility for childless, nondisabled adults was already set at 100% of FPL, so that the upper income eligibility limit for a single person increased from $11,670 to $16,105 on January 1, 2014*" (2020). This illustrates that even when Medicaid was expanded to the minimum 138%, some states' existing programs didn't expand coverage to the same magnitude as others.

Conclusion

This dissertation has examined the impacts of changes in financial standing on hospital quality of care. While no definitive relationship was found between these two variables, this analysis still contributes to the literature in several ways. First, it uses multiple regression models with fixed effects and control variables to effectively measure if the financial changes brought about by Medicaid expansion were truly exogenous. While other studies have examined similar questions that were addressed in this dissertation, none check the robustness of the financial shock as to whether it can be used in pre-post analysis that uses Medicaid expansion as the natural experiment (Camilleri & Diebold, 2019). Second, new measures of quality of care were

utilized. Most studies to date use outcomes-based measures like readmissions and mortality to examine hospital quality of care. Process of care measures were used in the core analysis of this dissertation. This is a contribution to the literature as there process of care of measures are rarely used to examine hospital quality of care. Such measures are important to track, especially for hospital and health system managers because they directly measure how care is delivered when patients are in the hospital. A third contribution of this dissertation is the use a full national sample of hospitals. Most studies in this area examine regions or states, for example California, that have much more data publicly available. By using Medicare COMPARE measures, I am able to examine all hospitals receiving Medicare payments. The findings of this research are more applicable and generalizable due to this nationally representative sample.

Medicaid expansion has been shown to have positive financial impacts for hospitals residing in states where coverage was expanded (Blavin, 2016; Camilleri & Diebold, 2019; David Dranove et al., 2016). However, this study does not find that the financial boon experienced by these hospitals led to any material differences in the quality of care being delivered. While this may be good news in part since quality of care was not adversely affected in non-expansion hospitals, it does help shed light on the complex relationship between hospital quality of care and financial performance. It is imperative that future research builds upon this research as this area of the literature is sparse, and very little is known about how these two variables interact with each other and are related over time.

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Appendices

Appendix A: Process of Care Full Sample Regression Results

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5
time	0.0694***	0.0569***	0.0717***	0.0842***	0.0842***
	(0.00521)	(0.00586)	(0.00265)	(0.00723)	(0.0141)
treated	0.0184***	0.0122**			
	(0.00620)	(0.00567)			
Expansion Effect	**-0.0159****	**-0.00919**	**-0.00962****	**-0.00708**	**-0.00708**
	(0.00785)	(0.00659)	(0.00432)	(0.00439)	(0.00755)
unemployment_rate		-0.00272		0.00426	0.00426
		(0.00199)		(0.00264)	(0.00473)
income_hh		7.40e-07***		-8.08e-07	-8.08e-07
		(1.56e-07)		(9.79e-07)	(1.50e-06)
case_mix_index		0.0877***		-0.0250	-0.0250
		(0.00892)		(0.0182)	(0.0238)
rural		-0.00518			
		(0.00513)			
white		0.0667***		0.693	0.693
		(0.0107)		(0.432)	(0.824)
medicare_pct_of_total		-0.0404***		1.53e-05	1.53e-05
		(0.0133)		(0.0138)	(0.0289)
Govt. Hospital Authority		-0.127***			
		(0.0195)			
Local Govt. Owned Hospital		-0.106***			
		(0.0202)			
State Govt. Owned Hospital		-0.0908***			
		(0.0204)			
Physician Owned Hospital		-0.0995***			
		(0.0241)			
Proprietary/For Profit Hospital		-0.0480***			
		(0.0175)			
Tribal Hospital		-0.484***			
		(0.148)			
NFP/Church Owned Hospital		-0.0743***			
		(0.0177)			
NFP Other Hospital		-0.0517***			
		(0.0175)			
NFP Private Hospital		-0.0671***			
		(0.0171)			
Constant	0.856***	0.766***	0.859***	0.442	0.442
Observations	5,905	4,935	5,905	4,935	4,935
R-squared	0.044	0.186	0.884	0.869	0.869
Hospital Fixed Effects	NO	NO	YES	YES	YES
State Level Cluster	NO	NO	NO	NO	YES

Appendix B: Process of Care Rural Sample Regression Results

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5
time	0.0904***	0.0718***	0.0907***	0.0947***	0.0947***
	(0.0106)	(0.0125)	(0.00528)	(0.0144)	(0.0227)
treated	0.0478***	0.0370***			
	(0.0134)	(0.0119)			
Expansion Effect	**-0.0210**	**-0.0224**	**-0.0193****	**-0.0219****	**-0.0219***
	(0.0163)	(0.0148)	(0.00883)	(0.00901)	(0.0127)
unemployment_rate		-0.00166		0.00704	0.00704
		(0.00337)		(0.00486)	(0.00792)
income_hh		3.14e-07		1.64e-06	1.64e-06
		(5.06e-07)		(1.94e-06)	(3.45e-06)
case_mix_index		0.272***		-0.0681	-0.0681
		(0.0267)		(0.0561)	(0.0952)
white		0.158***		-1.300	-1.300
		(0.0269)		(1.156)	(1.555)
medicare_pct_of_total		-0.0453*		0.0222	0.0222
		(0.0252)		(0.0161)	(0.0288)
Govt. Hospital Authority		-0.141***			
		(0.0320)			
Local Govt. Owned Hospital		-0.124***			
		(0.0329)			
State Govt. Owned Hospital		-0.115*			
		(0.0648)			
Physician Owned Hospital		-0.141**			
		(0.0637)			
Proprietary/For Profit Hospital		-0.0402			
		(0.0298)			
Tribal Hospital		-0.418***			
		(0.159)			
NFP/Church Owned Hospital		-0.0713**			
		(0.0313)			
NFP Other Hospital		-0.0699**			
		(0.0304)			
NFP Private Hospital		-0.0736**			
		(0.0290)			
Constant	0.803***	0.464***	0.817***	1.792**	1.792
	(0.00857)	(0.0652)	(0.00298)	(0.908)	(1.293)
Observations	2,210	1,580	2,210	1,580	1,580
R-squared	0.053	0.270	0.898	0.890	0.890
Hospital Fixed Effects	NO	NO	YES	YES	YES
State Level Cluster	NO	NO	NO	NO	YES

Appendix C: Outcomes Based Full Sample Regression Results

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5
time	-1.324***	-1.352***	-1.297***	-1.384***	-1.384***
	(0.0464)	(0.0557)	(0.0429)	(0.121)	(0.137)
treated	-0.0815	0.0581			
	(0.0608)	(0.0638)			
Expansion Effect	**-0.0234**	**-0.0517**	**-0.0260**	**-0.0358**	**-0.0358**
	(0.0817)	(0.0824)	(0.0723)	(0.0753)	(0.0942)
unemployment_rate		-0.0538***		-0.0368	-0.0368
		(0.0155)		(0.0416)	(0.0548)
income_hh		-1.42e-05***		5.33e-06	5.33e-06
		(1.88e-06)		(1.58e-05)	(1.92e-05)
case_mix_index		-0.473***		0.174	0.174
		(0.0888)		(0.417)	(0.477)
rural		0.0785			
		(0.0533)			
white		0.0852		0.0552	0.0552
		(0.108)		(7.754)	(12.03)
medicare_pct_of_total		-0.340**		-0.0371	-0.0371
		(0.154)		(0.108)	(0.172)
Govt. Hospital Authority		0.693			
		(0.510)			
Local Govt. Owned Hospital		0.425			
		(0.510)			
State Govt. Owned Hospital		0.707			
		(0.533)			
Physician Owned Hospital		0.445			
		(0.561)			
Proprietary/For Profit Hospital		0.554			
		(0.507)			
NFP/Church Owned Hospital		0.365			
		(0.509)			
NFP Other Hospital		0.388			
		(0.508)			
NFP Private Hospital		0.329			
		(0.506)			
Constant	14.25***	15.69***	14.21***	13.91**	13.91*
	(0.0342)	(0.555)	(0.0231)	(5.483)	(8.240)
Observations	3,831	3,617	3,831	3,617	3,617
R-squared	0.240	0.269	0.753	0.748	0.748
Hospital Fixed Effects	NO	NO	YES	YES	YES
State Level Cluster	NO	NO	NO	NO	YES

Appendix D: Outcomes Based Rural Sample Regression Results

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5
time	-1.203***	-1.195***	-1.114***	-1.370***	-1.370***
	(0.0834)	(0.0996)	(0.0886)	(0.236)	(0.331)
treated	0.190*	0.364***			
	(0.103)	(0.114)			
Expansion Effect	**-0.255***	**-0.307****	**-0.344****	**-0.356****	**-0.356***
	(0.142)	(0.152)	(0.155)	(0.157)	(0.181)
unemployment_rate		-0.0333		-0.0987	-0.0987
		(0.0253)		(0.0850)	(0.130)
income_hh		-7.97e-06		-9.46e-06	-9.46e-06
		(5.05e-06)		(2.96e-05)	(4.20e-05)
case_mix_index		-0.267		-0.743	-0.743
		(0.235)		(0.904)	(1.237)
white					
		-0.422**		-28.52	-28.52
medicare_pct_of_total		(0.211)		(25.11)	(40.22)
		-0.111		-0.0824	-0.0824
Govt. Hospital Authority		(0.0702)		(0.0650)	(0.106)
		1.335***			
Local Govt. Owned Hospital		(0.388)			
		0.924**			
State Govt. Owned Hospital		(0.386)			
		1.517**			
Physician Owned Hospital		(0.599)			
		2.227***			
Proprietary/For Profit Hospital		(0.608)			
		1.007***			
NFP/Church Owned Hospital		(0.377)			
		1.045**			
NFP Other Hospital		(0.411)			
		1.053***			
NFP Private Hospital		(0.384)			
		0.892**			
		(0.372)			
Constant					
	14.36***	14.65***	14.39***	39.34*	39.34
	(0.0606)	(0.609)	(0.0450)	(20.44)	(31.72)
Observations					
R-squared	960	855	960	855	855
Hospital Fixed Effects	0.273	0.285	0.759	0.748	0.748
State Level Cluster	NO	NO	YES	YES	YES
	NO	NO	NO	NO	YES