THE EFFECT OF GROWTH ON FINANCIAL REPORTING AND AUDIT QUALITY: EVIDENCE FROM ECONOMIC SHOCKS TO BANKS

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ABSTRACT

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Periods of rapid growth caused by shocks to a firm's economic environment represent a potential threat to financial reporting quality by presenting challenges to both the firm and its auditor. Despite the ubiquity of positive economic shocks, little is known of the extent to which these changes affect financial reporting and audit quality. Using exogenous economic shocks to local banks from oil and natural gas discovery and extraction, I find that financial reporting quality, measured by loan loss estimate quality, is lower in a period of rapid bank growth due to management's under-reaction to the positive economic shock. I also find that auditors with a combination of both task-specific and industry-specific expertise are more successful in mitigating the deterioration in financial reporting quality compared to auditors with general, Big 4 or industry-specific expertise alone. The findings suggest that a combination of industry and task-specific auditor expertise is needed to combat deterioration in financial reporting quality resulting from a positive economic shock

To Micah.
Psalm 34:3; Psalm 126:2-3

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CHAPTER 1: INTRODUCTION

Economic shocks, either positive or negative in nature, affect firm operations, management incentives and ultimately financial reporting quality. Prior research has focused on the effect of negative economic shocks on financial reporting quality (e.g., Iannotta and Kwan 2014; Barth and Landsman 2010), largely ignoring the possible consequences of positive shocks. The relative lack of evidence on the effects of positive shocks is an important omission given that such shocks are common and can occur at the macro-economy level (e.g., tax cuts, interest rate cuts), industry-level (e.g., government stimuli, technological development) or firm-level (e.g., patent development, large new customer, positive media attention). Positive shocks fundamentally differ from negative shocks in terms of incentives and challenges faced by firms, and while accounting standards are relatively straightforward in regards to negative shocks (e.g., impairments, curtailments), the appropriate accounting for positive economic shocks is largely left up to managerial discretion. Due to the importance of high quality and unbiased financial reporting for stakeholders during rapid growth periods, this study examines whether positive economic shocks negatively affect financial reporting quality and whether auditor expertise moderates the effect.

Rapid firm growth and organizational change have significant disruptive effects on a firm's operations, resulting in a greater propensity to report internal control deficiencies and restatements (Ashbaugh-Skaife, Collins and Kinney 2007; Doyle, Ge and McVay 2007). In addition, growth periods increase management's opportunity to intentionally manipulate financial statements, as managers of growth companies typically have greater discretion in operating and reporting decisions, including the development of accounting estimates (Smith and Watts 1992). An economic shock increases the uncertainty in a firm's operating environment and future cash flows, and increased uncertainty can result in severe and systematic errors in judgment (Tversky and Kahneman 1974), ultimately threatening the quality of accounting estimates.[1] Changes in business risk as a result of changes in general economic conditions have been cited by the Public Company Accounting Oversight Board (PCAOB) as increasing the risk of material misstatement, and specifically material misstatement of estimates (AS 2110; AS 2501). A positive economic shock should therefore affect the auditors' initial risk assessment, and ultimately, audit procedures performed. Given that financial reporting quality is the joint product of the firm and its auditor (Gaynor, Kelton, Mercer and Yohn 2016), I investigate the effect of both firm exposure and auditor characteristics on financial reporting following a positive economic shock.

Often, economic shocks resulting in rapid growth are systemic and widespread or arise from endogenous firm and industry characteristics, making it difficult to establish an appropriate counterfactual for analysis. In the banking industry, financial crises are often preceded by a period of rapid growth, with some suggesting crises are the result of the "credit boom gone bad" (Dell'Ariccia et al. 2012; Reinhart and Rogoff 2008). Such crises however, affect the entire financial services sector, making it difficult to identify control firms that were not affected by the crisis. Firm-specific shocks often arise due to characteristics of the firm itself, making the exposure to a shock endogenous. I overcome this challenge by examining banks exposed to exogenous liquidity windfalls from oil and natural gas shale development to investigate the impact of a positive shock on financial reporting quality. The technological breakthroughs that allowed natural gas and oil recovery from underlying shale deposits were largely unexpected and

[1] Consistent with the *Conceptual Framework for Financial Reporting* (FASB Concepts Statement No. 8), I define an estimate to be of higher quality when it is more informative regarding the prospects for future cash flows to an entity. High quality estimates are those prepared without bias (i.e., neutral).

resulted in a liquidity windfall for banks within highly localized regions. Due to the localized nature of shale-based shocks, a single state will contain some counties that are affected by the liquidity influx and economic changes from the shock, and some counties that are not. My identification strategy exploits this within-state variation using a geology-based measure of oil and natural gas endowment.

I focus my investigation on the banking industry as banks are significantly affected by a positive shale-based shock, yet do not have any effect on the nature and timing of the shock itself (Gilje et al. 2016). A second benefit of focusing on the banking industry is that, due to regulatory reporting requirements, financial information for both public and private banks is publicly available. Private banks with assets of less than $500 million are not required to be audited, which allows me to study the effect of variation in both external audit status (i.e., audited vs unaudited) as well as auditor type on estimate quality. Finally, the quality of the allowance for loan losses (ALL) reported by banks provides a proxy for financial reporting quality that is directly related to the effect of a shale-based boom.[2]

I use difference-in-difference estimation on a sample of 11,178 bank years from 2005-2014, to examine the effect of exposure to the positive shock on ALL quality. Consistent with positive shocks having a negative effect on financial reporting quality, I find that a bank's exposure to a positive economic shock results in lower estimate quality. Lower estimate quality can result from banks either over or under-reacting to a positive shock. I find that lower ALL quality following the shale boom is the result of management under-reacting to the shock by

[2] McNichols (2000) suggests the ALL is a fruitful account for evaluating financial reporting quality because it is material to the financial statements, subject to discretion, and tied directly to explanatory factors of interest. The ALL becomes more difficult to both develop and audit during periods of increased uncertainty surrounding future cash flows from loans, such as the period following a positive economic shock. I discuss the allowance for loan loss further in chapter 3.

failing to sufficiently adjust the ALL to account for the effects of the improvement in the bank's operating environment on the loan portfolio.

I then examine whether an external auditor moderates the relation between a positive economic shock and financial reporting quality. First, I find that the financial reporting quality in audited banks is not significantly different compared to unaudited banks following a positive economic shock. The finding suggests that, *on average*, auditors do not mitigate financial reporting quality deterioration due to a positive economic shock. I then examine the effect of specific auditor expertise on financial reporting quality of banks facing a positive economic shock by investigating the differential effect among auditors with 1) general expertise obtained through access to significant audit firm resources (i.e., Big 4),[3] 2) industry expertise and 3) task-specific expertise (i.e., previous experience auditing a client exposed to a shale-based shock) when clients are exposed to a positive economic shock. I do not find evidence that general audit expertise or Big 4 expertise mitigates deterioration in financial reporting quality during these economic shocks. However, I do find that banks audited by industry expert auditors and banks audited by task-specific experts are associated with higher financial reporting quality compared to banks audited by non-industry or non-task-specific expert auditors. Further investigation indicates that the higher financial reporting quality is isolated to clients of auditors with *both* industry and task-specific expertise. These results indicate that both industry and task-specific expertise is necessary for auditors to learn how, from prior experiences, to adjust audit procedures to address changes in their clients' operating environments.

Overall, this study finds that financial reporting quality varies based on economic conditions, and specifically that positive economic shocks are associated with a decline in

[3] Big 4 refers to the following audit firms: Deloitte, PriceWaterhouseCoopers, Ernst and Young and KPMG.

accounting estimate quality due to management under-reaction to the shock. This finding indicates that research on steady-state financial reporting quality does not capture a complete picture of the determinants of financial reporting quality, as findings may not generalize to periods of change in the economic environment. Additionally, the findings suggest that a combination of auditor industry and task-specific expertise is more effective at mitigating the effects of positive economic shocks, compared to traditional measures of expertise (i.e., Big 4 and industry expert) alone. Consistent with the PCAOB's emphasis on auditors gaining an understanding of their clients' operating environment, I find that access to firm resources and industry knowledge are not a substitute for intimate knowledge of the specific challenges facing a client in a period of rapid growth.

While the findings of this study clearly indicate a decline in financial reporting quality as defined by GAAP standards, the results do not speak to whether the bias of the ALL in a more conservative direction is optimal for bank stability. In this study, I focus strictly on financial reporting quality as defined by accounting standards, specifically that estimates should be developed without bias, regardless of the direction of the bias (AS 2501 ; SEC 2001; FASB SFAC No. 8).[4] It is notable; however, that a conservative bias in the ALL provides management with the opportunity for earnings smoothing, which dampens the discipline of bank risk taking, which can have widespread negative consequences for the financial system (Bushman and Williams 2012).

[4] SAB 102 quotes GAO report, "One of the GAO's principal findings was that most of the reviewed institutions' loan loss allowances included large supplemental reserves that generally were not linked to an analysis of loss exposure or supported by evidence. The GAO noted: "Such use of unjustified supplemental reserves can conceal critical changes in the quality of an institution's loan portfolio and undermine the credibility of financial reports." (GAO 1994; SEC 2001).

This paper contributes to the literature in three ways. First, prior studies on the effect of economic events on financial reporting quality focus on negative shocks or "crisis" situations. The lack of evidence on how growth affects financial reporting quality is an important omission in the literature, because positive shocks and periods of rapid expansion occur frequently in the economy and have different implications for firm and auditor risks, challenges, and incentives compared to negative shocks. Thus, the findings of this study have implications for future research by suggesting the need for a better understanding of how the changes in a firm's economic environment might affect evaluation of financial reporting quality.

In contrast to studies examining the effect of accounting *standards* during expansionary periods (e.g., Barth and Landsman 2010; Laux and Leuz 2009), I focus on the quality of financial reporting *information*. To the extent that financial reporting quality declines during growth periods, the standards themselves may be of secondary concern. While prior literature relies primarily on shocks that are systemic or in cross-country settings, I leverage a localized exogenous shock, which allows for stronger identification through the availability of a reasonable counterfactual.[5]

Second, I contribute to the banking literature by providing insight on how growth periods impact loan loss provisioning practices. Bank financial reports are intended to reduce the information asymmetry (i.e., opacity) that exists between banks and stakeholders (i.e., shareholders, debtholders and depositors); thus, if financial reporting quality declines, bank opacity is likely to increase. Bank opacity causes significant impediments in the interbank

[5] I acknowledge that this study focuses on a single economic shock in a specific setting. Although this focus allows for strong identification, the findings may not generalize to all situations of economic growth. However, disruptive challenges (e.g., internal control disruption, human capital constraints and capacity constraints) affect growth firms across all industries at various points.

market, which has repercussions for the economy as a whole (Acharya and Ryan 2016).[6] Additionally, I extend prior studies examining the relation between growth cycles and portfolio risk and composition (Berger, Minnis and Sutherland 2017; Dell'Ariccia, Igan and Laeven 2012; Dell'Ariccia and Marquez 2006; Lisowsky, Minnis and Sutherland 2017) by providing evidence that events influencing the risk of a bank's loan portfolio can have direct implications for financial reporting quality. Bank financial reporting quality has a widespread impact on the financial system.

Finally, I contribute to the auditing literature by providing evidence on how the economic environment of a client affects audit quality. This answers calls from Gaynor, Kelton, Mercer and Yohn (2016) and Knechel, Krishnan, Pevzner, Shefchik and Velury (2013) to examine how auditors adjust to client uniqueness and uncertainty and how different economic situations influence audit and financial reporting quality outcomes. Finally, I contribute to the literature on auditor expertise by providing evidence consistent with economic theory on the benefit of expertise obtained through experiences (Arrow 1962) and the importance of a combination of an auditor's industry-specific and task-specific expertise in responding to changes in a client's operating environment.

[6] Consistent with the banking literature, I consider higher bank opacity to exist when there is greater uncertainty of the value of a bank's underlying assets, and specifically the loan portfolio.

CHAPTER 2: RESEARCH SETTING AND HYPOTHESIS DEVELOPMENT

2.1. The Setting

2.1.1. Background on Hydraulic Fracturing

Prior to the 1990s, nearly all U.S. oil was recovered from "conventional" sources through traditional vertical drilling techniques. While hydraulic fracturing ("fracking") was used sporadically during the 1970's it was an expensive process that was not considered to be economically viable. However, new technology pioneered in the Barnett shale play[7] region combined with advances in horizontal drilling technology to decrease the cost of fracking and significantly increase the amounts of oil and gas considered to be economically recoverable around the country (Gilje et al. 2016). According to Allcott and Keniston (2018), the key areas affected by this increase in economically recoverable oil were the Bakken Shale in western North Dakota, the Niobara shale in eastern Colorado, the Marcellus and Utica shales in Pennsylvania, Ohio, New York, and West Virginia, the Barnett, Granite Wash, and Eagle Ford shales in Texas, the Woodford Shale in Texas and Oklahoma, and the Haynesville shale in Texas and Louisiana.

2.1.2 The Local Effects of Hydraulic Fracturing

> *"It's hard to think of what oil hasn't done to life in the small communities of western North Dakota, good and bad. It has minted millionaires, paid off mortgages, created businesses; it has raised rents, stressed roads, vexed planners and overwhelmed schools; it has polluted streams, spoiled fields and boosted crime...Oil has financed multimillion-dollar recreation centers and new hospital wings. It has fitted highways with passing*

[7] "Play" is a term used to refer to the shale formations that share similar geological properties, contain significant amounts of oil and/or natural gas, and are in a similar geographic area.

lanes and rumble strips. It has…brought job seekers from all over the country — truck drivers, frack hands, pipe fitters, teachers, manicurists….” (Brown 2013)

News reports from regions impacted by shale resource booms leave little doubt that there is a significant impact of an oil boom, with man camps springing up overnight, unemployment plunging to below 1% and rent rates skyrocketing to levels higher than experienced in the largest U.S. cities (Galbraith, 2012; Healy, 2013). The number of Americans working in the oil and gas industry increased by more than 40% between 2007-2012 (Hefner, 2014). An increase in crime also has accompanied the economic growth, with western North Dakota and eastern Montana experiencing a 32% increase in crime since the boom began (Healy, 2013), and while there is no debate as to whether resource booms lead to immediate job growth, questions linger as to the sustainability of the jobs in the long run (Moretti, 2013). In addition to the economic and social impacts of resource booms, the potential environmental impacts must also be considered (Urbina and McGinty, 2011). Given the many competing factors, the answer to the question of whether resource booms have a positive net impact, in the long or the short-term is not readily apparent and has been the subject of extensive research.

Prior economics research into the impact of shale resource booms has focused on local impacts, as resource booms, particularly shale-based booms are highly localized and there is heterogeneity in the local impacts of a boom. Using the interaction of local geology and technological development as an exogenous shock, Feyrer et al. (2017), find that over half of fracking revenue stays within the regional economy, with every million dollars of new oil extraction producing $132,000 in royalty payments and business income, $80,000 in wage income, and 0.85 jobs within a community. Fracking has spillover effects onto other industries within the local geographic area, as these industries may benefit from the additional money in the region, but also must compete for talent in a much tighter labor market, and may be unable to keep up with the wage increases required to attract and retain talent. Jacobsen (2017) finds that local wages increase across all major occupational categories, regardless of whether those occupations experienced changes in employment. The impact of employment growth is not limited to the oil and gas industry alone, but is attributed to significant cross sectional employment growth across U.S. industries and a $3.5 trillion increase in aggregate U.S. market capitalization from 2012-2016 (Gilje et al., 2016).

The crowding out of other industries, at the expense of focusing on natural resources can have a negative overall impact known as "Dutch Disease." The potential for such spillovers has been examined extensively in the manufacturing sector, with some studies concluding that there is no evidence of Dutch Disease (e.g., Allcott and Keniston 2018), while others have argued that the income specialization that comes along with resource booms can reduce income per capita, increase crime and reduce educational attainment in the long run (e.g., Haggerty et al., 2014). In studies of the boom and bust cycles, the short-run economic benefits are clear, as there is a positive impact on local employment; however, in the long run, results are mixed with studies finding both positive and negative impacts on local communities (e.g., Jacobsen and Parker 2016; Allcott and Keniston 2018). One potential reason for discrepancies in the findings of prior research is that there is significant heterogeneity in the local net impacts, thus while the overall impact may be positive, the benefits are not evenly distributed or experienced across various local communities (Bartik et al., 2016). The findings of Muehlenbachs et al. (2015), support the conclusion that the impacts of shale development are not evenly spread as they examine the fluctuations in the values of specific properties in the Pennsylvania shale region from 2002-2015. They find that the negative impacts on property value are closely tied to the potential negative environmental impacts of fracking, as homes that rely on piped waters were largely unaffected, while homes dependent on groundwater suffered a significant decline in value. The heterogeneity of the effects of the shale boom make it an ideal setting to examine the effect of localized economic shocks.

The new technology and time series variation associated with shale oil booms also creates a setting in which to test the theory of learning by doing (Arrow, 1971), as the rapid technological change and race to capitalize on the new opportunities in shale resource production resulted in a steep learning curve. Research has largely found support for the theory that companies learn from their experiences with hydraulic fracturing, as wells become more productive with time (Fitzgerald, 2015). However, the learning process occurred slowly and incompletely, as Covert (2014) estimates that companies are successful at capturing only 67% of potential fracking profits. The challenges associated with the new technology, along with unexpected swings in oil prices made it difficult for companies invested in fracking to be profitable initially, driving more than 120 companies into bankruptcy and resulting in losses in the billions; however, the lessons learned from the early fracking laid the groundwork for future profitability (Olson, 2017). Due to continuous learning and experimentation, as well as increases in scale, one company was able to reduce its production costs by 40 percent over an 18 month period (Hefner, 2014).

Similarly, auditors would be expected to learn from their prior experiences with resource-booms, thus the variation in timing and geography of the oil booms provide an ideal setting to test whether auditors gain experience-specific expertise through learning.

2.1.3 Hydraulic Fracturing Effect on Banks

Shale booms provide an opportunity to study the effects of economic shocks in general, and on banks specifically (e.g., Plosser 2013; Gilje, Loutskina and Strahan 2016). The discovery of shale oil and gas has an immediate effect on both the supply of funds and demand for credit faced by banks in exposed areas. Royalty payments and lease payments are made to private landowners who deposit funds in banks, resulting in a liquidity windfall for banks and a sharp increase in supply of funds for bank investment.

In the United States, landowners have rights to not only the surface of their property, but also to the minerals below the surface (Hefner 2014). The market for oil and gas extraction has historically been dominated by small, independent companies, resulting in intense competition for leases, thus driving the value of mineral rights upwards (Davidson 1963). Money is paid to mineral owners in two stages. First, energy extractors make an initial lease payment for the right to explore a landowner's property and extract minerals. Second, landowners are paid ongoing royalties based on the productivity of the wells on their properties. Royalty amounts can be substantial, with estimated royalties paid to private landowners in the U.S. exceeding $39 billion in 2014 (Brown et al. 2016). Considering both the sizeable upfront lease payment and continuing royalties, an owner of 100 acres could conceivably receive $3 million in lease and royalty payments over a 20-year period. Landowner royalties primarily accrue locally, while revenues earned by oil and gas companies often flow out of the local county or state (Fitzgerald 2014).

Royalty payments, increased wages, and higher business income result in an inflow of cash to the localized community during a fracking boom. The cash inflow leads to an increase in both supply of liquidity to banks in the form of deposits and a decline in the cost of deposits (Gilje et al. 2016).The increased supply of funds allows banks to meet the increase in demand for credit that accompanies fracking booms. The availability of jobs and opportunities associated with oil and gas bring people to the impacted areas, increasing housing demand and subsequently rents. As rents skyrocket, there is a rush to construct new housing units, increasing the demand for loans to finance the construction. New businesses also open to capitalize on the increased population and wealth increasing the demand for commercial loans in the area.

Theoretical models suggest that lending standards vary across a bank's business cycle, and credit boom periods lead to an increase in the risk of bank loan portfolios (Dell'Ariccia and Marquez 2006; Ruckes 2004). Empirical research supports these models by finding that bank crisis periods can be tied to relaxed lending standards and movement away from requiring audited financial information from borrowers during expansionary periods (Dell'Ariccia et al. 2012; Lisowsky et al. 2017). Such a change in underwriting standards alters the risk inherent in a bank's loan portfolio.

In addition to impacting new loans made by banks, shale boom shocks also affect the operating environment of borrowers in a bank's existing loan portfolio. The boom period has a positive impact on business operations for many businesses in affected areas (Allcott and Keniston 2018; Feyrer et al. 2017) and; therefore, the boom alters the risk of local borrowers within a bank's existing loan portfolio. Borrowers' growth generally improves their cash flow and ability to service loans, which results in a downward shift in expected charge-offs, at least in the immediate future. While decreases in charge-offs are positive for bank operations, the departure from historical loan charge-off patterns results in challenges for bank management as they attempt to accurately estimate loan losses.

Thus, banks exposed to fracking booms experience organizational challenges due to changes in the risk of their existing loan portfolio, as well as changes in both the supply of funds and demands for new credit. Periods of organizational change and rapid growth increase uncertainty, the likelihood of internal control deficiencies (Ashbaugh-Skaife et al. 2007; Doyle et al. 2007), and management's opportunity to intentionally manipulate earnings (Smith and Watts 1992). These changes present a clear challenge to financial reporting quality; thus, I make the following hypothesis, stated in alternate form:

H_1: *Exposure to a positive economic shock will negatively affect the financial reporting quality of banks.*

While the challenges facing banks are clear, what is unclear is whether these challenges will result in over or under-reaction to a positive shock. Understanding the direction of management's reaction is critical to understanding, and ultimately mitigating, negative effects of positive shocks.

2.2 The Role of the Auditor

As financial reports are a joint product of management and the auditor (Gaynor et al. 2016; Francis 2011; DeFond and Zhang 2014) auditor characteristics may affect the relation between a positive economic shock and financial reporting quality. Auditing standards require auditors to gain an understanding of the business practices of their clients and the economic environment in which their clients operate (AS 2110). Some of the most serious allegations made against audit firms by the SEC and clearest instances of audit failure result from the auditor's failure to understand their client's business practices and economic environment (Hall and Renner 1988). A case study by Erickson et al. (2000) finds that the audit failure of Lincoln

Savings and Loan (LSL) was caused by the auditor's failure to understand business practices and the economic environment in which its client operated. Specifically, the auditor did not evaluate the substance of LSL's wholesale land sale transactions in the context of the economic environment, leading to inappropriate accounting treatment of the transactions. This shortcoming resulted in the failure of the client, and litigation for the audit firm, ultimately leading to a settlement of more than $135 million.

The need for auditors to adjust to changes in the economic environment is highlighted by the PCAOB's recent emphasis on the importance of auditors understanding of the effect of disruptive events, including economic shifts and technological changes (Amble, Gallagher, Joseph, and Peters 2015). Accounting estimates are an area where an understanding of changing business practices is particularly important, the auditing standards explicitly require that auditors consider the impact of changes in a firm's business or industry on key estimate assumptions. Furthermore, prior literature has shown that auditors are able to influence accounting estimate accuracy (AS 2501; Petroni and Beasley 1996).

Dynamic changes in a client's economic environment increase the information asymmetry between client and auditor, as the auditor is forced to "play catch-up" to understand the underlying nature of the changing business practices. One way auditors gain a greater understanding of business practices is through expertise (e.g., Balsam, Krishnan and Yang 2003; Gul, Fung and Jaggi 2009; Lim and Tan 2008; Reichelt and Wang 2010). Expertise can be general in nature, arising from knowledge of financial reporting and auditing procedures. General expertise can be obtained through access to significant firm-level resources (e.g., human resources, talent, large professional standards groups, access to a broad geographic network), as evidenced by the higher quality of Big 4 audits identified in prior research (e.g., DeFond and

Zhang 2014). Expertise can also arise from extensive experience within a particular industry, and industry specialist auditors are more likely to detect financial misstatements because of their ability to identify a pattern in multiple, seemingly innocuous, cues (Hammersley 2006). Expertise is of particular importance in evaluating complex estimates, because effective auditing of estimates requires auditors to appropriately incorporate a wide range of information, and expert auditors are better equipped to identify relevant information and contradictory evidence to incorporate into their analysis of the reasonableness of accounting estimates (Griffith, Hammersley, Kadous and Young 2015). In the specific case of the allowance for loan losses, industry-expert auditors assess risk differently than non-specialist auditors by properly identifying the valuation assertion as being the most important for the loan loss allowance (Taylor 2000).

In addition to industry expertise, auditors draw on specific prior experiences to develop task-specific expertise. Bonner and Lewis (1990) find that general experience explains less than ten percent of variance in the performance scores of experimental subjects. As learning is the product of experience and occurs during the performance of a task (Arrow 1962), it is specific experience that is critical, as auditor judgment is impacted by their previous experience (O'Reilly, Leitch and Wedell 2004). As auditors gain experience, their knowledge of the set of potential financial statement errors becomes more complete, and they are better able to understand the interaction of financial statement errors with the transaction cycle (Libby and Frederick 1990).[8] In evaluating the assumptions underlying the calculation of accounting estimates, auditors with less experience are more likely to rely on management-provided

[8] Further supporting the importance of task-specific expertise, Shepardson (2018) finds that individual audit committee members' task-specific expertise affect financial reporting outcomes in a manner consistent with conservatism.

information, rather than exercising professional skepticism and are less likely to deflect attempts by management to persuade auditors of the appropriateness of accounting numbers (Kaplan, O'Donnell and Arel 2008).

During periods of economic change, it becomes more difficult for an auditor to evaluate the reasonableness of management assertions, thereby increasing the importance of auditor expertise. Studies of expert judgment find that experts must be able to identify, organize, measure, weigh, and combine cues in coming to a judgment (Slovic 1969; Einhorn 1974). "The expert's ability to identify cues can be seen as a problem of extracting weak signals from a background of noise" (Einhorn 1974); however, the greater the noise in the background, the more difficult the job of the expert becomes and it is unclear whether an expert would retain an advantage. Comparability across clients audited by an expert also declines during a period of rapid growth, which can have a negative effect on analytical audit procedures which rely on the relative comparison of a bank to its peers. Thus, if a bank becomes less comparable to other banks in the auditor's client portfolio, it becomes difficult to identify appropriate benchmarks.[9] With the declining availability of appropriate benchmarks, the benefits of the expert's general knowledge of banking industry clients may become less applicable. An auditor's failure to recognize and adjust to the changing economic environment facing their clients could exacerbate these challenges. Furthermore, in situations where decision makers are constrained, evidence points to a decline in the advantage of experts compared to non-experts (Hoffman et al., 2003), and not all types of experts exhibit superior performance compared to non-experts (Moroney, 2007).

[9] The benefit of having appropriate benchmarks in auditing is related to the theory of relative performance evaluation often cited in compensation literature (Lazear and Rosen 1981; Nalebuff and Stiglitz 1983).

Finally, it is unclear whether the positive effects of auditor expertise documented in prior literature would apply uniformly across growth, decline and steady-state periods. While both decline and growth periods present challenges to an auditor in terms of changing economic environment and increased uncertainty in developing accounting estimates, the risks facing an auditor differ. One example is litigation risk, which is a significant risk for audit firms.[10] Prior literature suggests that auditor's behavior may vary based on litigation risk in response to PCAOB inspection findings (Christensen et al. 2018) and that higher litigation risk results in greater audit effort, as suggested by higher audit fees (Choi et al. 2008; Seetharaman et al. 2002). Because auditor legal disputes are typically triggered by an event resulting in material loss, such as a client bankruptcy, intuitively, the risk facing an auditor is lessened during a high-growth period when overall risk of client failure or bankruptcy is reduced (Maksymov et al. 2018). In contrast, in a decline period, auditor litigation risk may be heightened, leading to greater auditor effort in which expertise would be most beneficial. Thus, it is *ex ante* unclear whether auditor expertise would have a similar effect following a positive economic shock resulting in lowered litigation risk, compared to steady state periods or periods following a negative economic shock.

Given the competing arguments of how a dynamic growth environment might affect the efficacy of auditors, I make the following hypothesis, stated in null form:

H_{2a}: *The change in financial reporting quality following a positive economic shock will not be affected by general auditor expertise.*

[10] A 2008 report from the U.S. Department of the Treasury indicates that litigation-related costs represent 6.6 percent of the audit revenues of the six largest U.S. audit firm (U.S. Department of the Treasury 2008).

CHAPTER 3: METHODOLOGY

3.1 Primary Empirical Measures

3.1.1 Identification of affected banks

Oil and gas production decisions are influenced by several factors such as local infrastructure and economic conditions. These factors could be correlated with the quality of a local bank's loan portfolio and ultimately the financial reporting quality of banks in any given region. In contrast, *ex ante* oil and gas endowment is based solely on geological properties of underlying shale formations, which are unlikely to be correlated with bank financial reporting quality.[11] For this reason, I use the variation in *ex ante* oil and gas endowment as the basis for identification in this study. To measure *ex ante* oil and natural gas endowment, I use a measure constructed by Allcott and Keniston (2018). This measure of oil and gas endowment expands beyond oil and gas production to include both proven and undiscovered oil and gas reserves. Undiscovered reserves are based on estimates by the U.S. Geological survey, which defines "undiscovered petroleum (as) that which is postulated from geologic knowledge and theory to exist outside of known accumulations" (Schmoker and Klett 2013). The expansion of the measure of a bank's exposure to a fracking shock to include data outside of historical oil and gas production is critical to the exogeneity of the measure, as it is unlikely that a bank chooses branch locations based on the geological properties of the location, especially absent proven oil and natural gas reserves. APPENDIX A contains further details of the calculation of the measure of oil and natural gas endowment, as well as the procedures I perform to validate the measure.

[11] I define endowment to be the total amount of oil and natural gas existing within shale formations before the commencement of any production activity. Endowment encompasses all oil and gas that has been produced and estimates of all oil and gas that ever will be produced within a given county.

Another key component contributing to the exogeneity of the identification measure is the unexpected nature of the technological breakthroughs allowing the extraction of resources from shale formations. The rapid development of shale-based oil and gas production surprised even the experts in the field, making it unlikely that banks had either the necessary knowledge or the time to adjust their strategy or governance structures in anticipation of the fracking boom.

Resource endowment density varies within shale plays; thus, I identify high versus low endowment counties based on the county's endowment relative to other counties within a single shale play. I consider any county that is above the median for endowment density within a given shale play to be highly endowed (*Endowed* = 1); while I consider all counties located within a state over a shale play (i.e., play state) and are below the median in endowment density as low-endowment counties (*Endowed* = 0). This allows me to use counties that are geographically close, but have lower or no oil and gas endowment as a control group for the analysis.[12]

I use the FDIC Summary of Deposits data from 2005-2014 to identify bank branch locations. I construct a continuous county-bank-year measure of exposure (*Exposure*) to the fracking booms by determining the proportion of a bank's branches located in a county where *Endowed* = 1. The measure ranges from zero for banks with no branches in endowed counties to one for banks with all branches in endowed counties.[13] As a secondary test, I also construct a dichotomous measure to identify exposed banks using the indicator variable *Exposed*, which is

[12] APPENDIX C provides further details on the identification of treatment and control counties and Figure 2 presents a map of treatment and control counties. In a robustness test described in chapter 5, I use the continuous measure of endowment and document qualitatively similar results.

[13] While a county's level of endowment does not change over time, an individual bank's exposure to a fracking shock can vary over time based on the locations of its branches. I use the time-varying exposure measure for the main analysis, as it more accurately captures the time-varying nature of a bank's exposure to fracking shocks. The results are robust to the use of an *ex ante* (as of 2007) bank exposure measure, which mitigates bank self-selection concerns. The analysis is discussed in greater detail in chapter 5.

equal to one if the majority of a bank's branches are located in a county where *Endowed* = 1 in year *t*, and zero otherwise.

3.1.2 Allowance for loan losses

I use allowance for loan losses (ALL) quality as a proxy for financial reporting quality in this study. When using specific accrual accounts to assess financial reporting quality it is important to identify an account that is material, subject to discretion, and that can be tied directly to explanatory factors of interest (McNichols 2000). The ALL is typically the largest estimate on a bank's balance sheet and has implications for bank lending, opacity, and overall systemic risk (Beatty and Liao 2014; Bushman and Williams 2012; Iannotta and Kwan 2014). It is subject to a high level of management discretion, making it susceptible both to management bias and manipulation (Beatty and Liao 2014), and prior literature has found that bank management uses the ALL to manage earnings (e.g., Beatty et al. 2002) and capital (Ahmed et al. 1999). The ALL is directly impacted by loan portfolio composition and loan growth; therefore, I can link the disruptions that occur in a time of rapid growth directly to the ALL estimate.

Some prior literature examines the loan loss provision (LLP), which is a measure of the change in the ALL, net of charge-offs and recoveries. In this study I focus on the ALL, which is the estimate of expected losses inherent in the portfolio as of the balance sheet date. Although analysis of the LLP may be appropriate in a static environment, in a dynamic environment, such as following an economic shock, the analysis of the ALL is more appropriate, because the LLP is influenced by inaccuracies in the beginning balance of the ALL and is essentially a "plug" figure after the necessary allowance balance is calculated. Furthermore, the quality of the ALL is the focus of both auditors and regulators.[14]

The ALL at period-end is the estimate of expected losses inherent in the existing loan portfolio as of the balance sheet date. Standards require losses be recognized when it is considered unlikely that the bank will collect all contractual payments of principal and interest. The appropriate loan loss allowance is determined based on a two-part calculation. A reserve for non-performing loans is determined on a loan-by-loan basis using methodology outlined following ASC 310-10 (FAS 114) and loans that are performing are pooled and evaluated based on loan type following ASC 450 (FAS 5). The required reserve rate for pooled loans is determined for each loan type based on the bank's loss history and is adjusted for qualitative risk factors (e.g., economic factors) as determined by the bank. Once a loan is deemed uncollectible, it is charged-off and removed from the loan portfolio and the allowance.

The quality of the ALL can be evaluated *ex post* based on subsequent charge-offs, making it an attractive estimate for empirical analysis. The SEC's Staff Accounting Bulletin (SAB) 102 outlines the procedures that should be used to validate loan loss accounting methodology. The bulletin states that, "a registrant's loan loss allowance methodology is considered valid when it accurately estimates the amount of loss contained in the portfolio. Thus, the staff normally would expect the registrant's methodology to include procedures that adjust loan loss estimation methods to *reduce differences between estimated losses and actual subsequent charge-offs* (SEC 2001)." Thus, in a perfectly accurate ALL, the ratio of subsequent charge-offs to the current ALL should be 1 (i.e., there is no difference between the ALL and

[14] The results of this study are robust to conducting the analysis using the LLP and following the model of Altamuro and Beatty (2010), which examines the association between current period LLP and future period charge-offs. This model is discussed in detail in chapter 5.

subsequent charge-offs).[15] I consider one year to be the appropriate time period over which to examine subsequent charge-offs, as according to the OCC's Comptroller's Handbook, "Many banks consider coverage of one year's losses an appropriate benchmark of an adequate reserve for most pools of loans…A one-year coverage period is generally considered appropriate because the probable loss on any given loan in a pool should ordinarily become apparent in that time frame (OCC 2012)." Examining charge-offs over the subsequent one-year period is also consistent with prior literature (e.g., Bushman and Williams 2012; Nicoletti 2018; Altamuro and Beatty 2010). Based on the relationship between loan charge-offs (CO) and the ALL, I use the ratio of charge-offs in *t+1* to ALL in *t* (CO/ALL ratio) to evaluate the quality of the ALL estimate.

A portion of this study focuses on the influence of an expert auditor on financial reporting quality; thus, it is important that the financial reporting quality proxy chosen is appropriate for use in evaluating the effect of auditor expertise. Prior literature has shown that experience matters most when the task being performed is complex (Hamilton and Wright 1982; Abdolmohammadi and Wright 1987), and proper evaluation of auditor expertise necessitates a task to require cue selection and weighting (Bonner 1990; Dawes 1979; Einhorn 1974). Simon's (1960) model separates tasks into structured, semi-structured, and unstructured, with the semi-structured and unstructured tasks being the most complex. The audit of the ALL can be considered a semi-structured task (Wright 2001). The calculation of the ALL requires extensive analysis and understanding of the importance of many factors across loan type and structure, as

[15] The discussion of the timing of loan charge-offs and the relationship to the ALL in this paper is based on the incurred loss model according to ASC 310-10 (FAS 114) and ASC 450 (FAS 5), because these are the standards in place as of the sample period. In June 2016, the FASB issued ASU No. 2016-13, which introduced the Current Expected Credit Loss (CECL) methodology which will replace the incurred loss model. See APPENDIX D for further discussion of the Incurred Loss Model vs CECL model.

well as the effect of a bank's environment on loan characteristics (Wright 2001). Based on these criteria, auditing of the ALL represents an appropriate task to evaluate the benefit of auditor expertise, as it is both semi-structured and requires the identification and weighting of numerous cues.

3.2. Research Design

3.2.1. Hypothesis 1: Effect of a positive economic shock on ALL quality

As with any event study, examining the impact of the fracking boom on ALL quality presents the challenge of disentangling the impact of rapid growth from other changes in economic conditions during the period. The exogenous nature of exposure to a fracking shock mitigates concerns of *ex ante* correlation between exposure and bank financial reporting quality; however, the analysis could be confounded by other local economic trends over the sample period. To address this concern, I use banks with less or no exposure within the same state as a control group in a difference-in-differences research design. The use of difference-in-differences estimation mitigates concerns that time-trends or contemporaneous events may influence the results (Roberts and Whited 2013). The test of Hypothesis 1 estimates the impact of exposure to a fracking shock on ALL quality using the following model:

$$ALL\ Quality = \alpha + \beta_1 Post_{it} + \beta_2 Exposure_{it} + \boldsymbol{\beta_3 Post{*}Exposure_{it}}$$
$$+ \beta_4 Size_{it} + \beta_5 NPA_{it} + \beta_6 Consumer_{it} + \beta_7 C\&I_{it} + \delta_s + \lambda_t + e_{ist} \qquad (1)$$

where subscripts refer to bank (i), state (s) and year (t), and variables are defined as follows:

ALL Quality$_{it}$	the ratio of charge-offs in year *t+1* to ALL in year *t*[16]
Post$_{it}$	indicator variable equal to 1 if significant fracking activity has commenced in a state where bank *i* has branch locations, 0 otherwise
Exposure$_{it}$	proportion of bank *i*'s branches located in counties where *Endowed* =1 in year *t*
Size$_{it}$	natural log of total assets at the beginning of year *t*
NPA$_{it}$	non-performing assets at the end of year *t* scaled by beginning total assets
Consumer$_{it}$	amount of consumer loans at the end of year *t*, scaled by total loans.
C&I$_{it}$	amount of commercial and industrial loans at the end of year *t*, scaled by total loans.

I include time fixed effects (λ_t) to control for time effects across all observations, and I include state fixed effects (δ_s) to control for time-constant state characteristics. In the population, 99 percent of banks have a CO/ALL Ratio of less than one, indicating that in nearly all cases, banks are over-reserved based on relevant standards for loan loss estimation as previously discussed. This indicates that, in general, the ALL estimate is biased in a conservative direction; however, such a bias is not in line with SEC and PCAOB guidance that estimates should be developed without bias, regardless of the direction of the bias (AS 2501 ; SEC 2001; FASB SFAC No. 8).

[16] The ratio of charge-offs in year *t+1* to ALL in *t* (CO/ALL ratio) is slightly right skewed (skewness = 2.62). However, in the sample, the mean value of CO/ALL is 0.184. Given this small value, interpretation of the coefficient of interest (β_3) is challenging using the log specification of the dependent variable (ln[1+CO/ALL]) as 100*β_3 approximates the change in percentage change in CO/ALL for a one unit change in *Post*Exposure* only when CO/ALL is large. Thus, for the main analyses I use CO/ALL as the dependent variable of interest. To mitigate concerns regarding the non-normality of ALL Quality, I estimate model (1) using ln(1 + CO/ALL) and derive the interpretation β_3. I find results consistent with the primary analysis.

Given that nearly all banks are over-reserved, for the analysis, I remove all under-reserved bank-years for ease of interpretation of results.[17] Thus, a higher CO/ALL ratio is indicative of less conservative bias (i.e., more neutral) and greater ALL quality.

In this study, I am interested in how exposure to the shale boom impacts ALL quality. I use a difference-in-differences approach where the first difference (β_2) represents the relationship between ALL quality and the proportion of bank branches in high-endowment counties prior to the boom's onset, and the difference-in-differences estimator (β_3) represents the difference in the relationship between ALL quality and *Exposure* after onset. A negative coefficient on β_3 indicates that the ratio of charge-offs in $t+1$ to ALL in t is lower in the post-boom period when a greater proportion of a bank's branches are in an endowed county.

I include the log of bank assets (*Size*) to control for variation in ALL quality based on the size of a bank. In addition to size, both the credit quality and composition of a bank's loan portfolio can influence the quality of the ALL. Consistent with prior literature, I control for the credit quality of a bank's loan portfolio with the level of non-performing assets (*NPA*), which includes loans that are troubled debt restructures, greater than ninety days past due, or for which interest revenue is not being currently recorded as well as foreclosed real estate (Beatty and Liao 2014). To control for the effect of loan portfolio composition on ALL quality, I include controls for the proportion of consumer loans and commercial and industrial loans in the portfolio (*Consumer* and *C&I*).[18]

[17] In an additional analysis, I include both over and under-reserved banks and estimate model (1) using the absolute value of one minus CO/ALL ratio (i.e., an estimate of ALL error) rather than *ALL Quality* as the dependent variable. The results are qualitatively similar to the results in the main analysis.

[18] Consistent with Beck and Narayanamoorthy (2013), I do not include economic control variables, because the ALL estimation should consider economic conditions. Furthermore, the primary interest of this study is regarding how changes in economic conditions affect ALL quality; thus, including variables to control for differences in economic conditions is inappropriate.

The use of the continuous variable *Exposure* provides information regarding how ALL quality varies with the level of *Exposure*; however, the most significant effect of the shale boom would be expected when comparing banks with no exposure (i.e., *Exposure* = 0) to banks with any level of exposure (i.e., *Exposure* is greater than zero). To examine this relationship, I also estimate model (1) and replace *Exposure* with *Exposed*, an indicator variable equal to 1 if any of bank *i*'s branches are in a county with oil and gas endowment above the median within a shale play in year *t*, zero otherwise.

The onset of boom is considered to be the first year of significant public drilling activity in a shale play and is identified consistent with Bartik et al. (2016) as follows: Permian (2005), Marcellus (2007), Bakken (2007), Andarko (2008), Eagle Ford (2008), Haynesville (2008), Niobrara (2010), Utica (2011). While these dates are consistent with information for the U.S. Energy Information Administration (EIA) and prior literature, I acknowledge that the onset of the boom does not occur at a single point in time. I conduct additional analysis that does not require a precise definition of pre-and post-periods and find consistent results. The additional analysis is described in detail in chapter 5.

3.2.2. Hypothesis 2: Effect of the auditor on ALL quality during a positive economic shock

To test H2, I estimate the effect of auditor expertise on ALL quality during a shale boom using four measures of auditor expertise. First, I use audit status to capture the effect of general financial reporting expertise provided by an auditor, compared to non-audited banks. *Audited* is an indicator variable equal to 1 if the bank is audited in year *t* and zero otherwise. Second, I use the presence of a Big 4 auditor to capture the effect of general audit expertise obtained through access to greater firm resources. I define *Big4* as an indicator variable equal to 1 if the bank was audited by a Big 4 auditor in year *t* and zero otherwise. Third, I define an industry expert auditor as an auditor in the top 10 percent of auditors in total count of audit clients within the banking industry.[19] I define *IndExpert* as an indicator variable equal to 1 if the bank was audited by an industry expert auditor in year *t* and zero otherwise. Finally, I define a task-specific expert auditor as an auditor with previous experience auditing a bank exposed to the shale boom. The experience of these auditors provides them with specific knowledge of the challenges faced by clients exposed to the boom, which may be beneficial in the planning and performance of audit procedures. I define *SpecificExpert* as an indicator variable equal to 1 if the bank was audited in year *t* by an auditor with task-specific expertise and zero otherwise.

I estimate model (1) separately for subsamples of banks based on the types of auditor expertise and compare the coefficient on *Post*Exposure* across the separate regressions.[20] Specifically, I compare the following four subgroups: 1) Audited vs. unaudited; 2) Big 4 vs. non-Big 4; 3) industry expert vs. non-industry expert; 4) task-specific expert vs. non-task-specific expert.

For the comparison of audited and unaudited banks, I limit the sample to banks with less than $500 million in assets. All banks with assets greater than $500 million are required to be audited; thus, the audit choice estimation is limited to those banks below the $500 million

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[19] I proxy for banking industry expertise by calculating the expert measure based on all banks within my sample. Given that all banks are required to file regulatory Call Reports, regardless of size and issuer status, the sample constitutes a reasonable proxy for the entire banking industry. Due to data limitations, I am unable to use audit fee-based measures of expertise.

[20] In an untabulated test of hypothesis 2, I add an interaction of the auditor characteristic of interest to model (1) and estimate the following model: $ALL\ Quality = \pi_1 Post_{i,s,t} + \pi_2 Exposure_{i,s,t} + \pi_3 Post{*}Exposure_{,s,t} + \pi_4 Auditor_{i,s,t} + \pi_5 Post{*}Auditor_{,s,t} + \pi_6 Exposure{*}Auditor_{,s,t} + \pi_7 Post{*}Exposure{*}Auditor_{,s,t} + \sum Controls + e_{i,s,t}$. where Auditor is the audit expertise measure of interest. I estimate the model first using *Audited*, then using *Big4*, *IndExpert*, and *SpecificExpert*. The coefficient of interest (*Post*Exposure*Auditor*) is consistent with the results of the analysis of separate subsamples. I consider the use of subsample analysis to be a stronger analysis as it simulates a fully interacted model; thus, I rely on the subsample comparison for my main analysis.

threshold.[21] For the Big 4, industry and specific expertise analyses, I limit the sample to audited banks to isolate the incremental benefit of auditor expertise compared to auditors without such expertise.

[21] The legislation governing bank audit requirements is the *Federal Deposit Insurance Corporation Improvement Act of 1991* (FDICIA). By limiting the sample to only those banks below the threshold for a mandatory audit, I can isolate the effect of the audit choice. Furthermore, limiting my sample based on size allows for greater comparability of the banks within the sample, as one of the primary determinants of audit choice is size.

CHAPTER 4: DATA AND RESULTS

4.1. Sample

Table 1 details the sample selection process. I begin with all banks filing at least one Call Report from 2004 to 2015, and merge the database of Call Reports with the regulatory reports for each bank's holding company (FR Y-9C) to obtain the auditor identity.[22] I limit the sample to year-end regulatory reports. The sample period begins in 2005, as auditor identity is not publicly available on the FR Y-9C prior to that date. The analysis is conducted at the bank level, and consistent with prior literature (e.g., Nicoletti 2018), I do not restrict the analysis to stand alone banks (i.e., those not held by a holding company) as doing so would result in the loss of most banks of economic and practical interest as the majority of U.S. banks are held by holding companies (Avraham et al. 2012).

I use 2004 Call Report data to obtain necessary lagged variables for the analysis, which allows me to retain 2005 in the sample. The dependent variable of the main model requires leading charge-offs, limiting the sample period to 2005 to 2014. I use the FDIC's Summary of Deposit information to determine bank branch locations for each year of the sample period.

I identify eight major U.S. shale regions based on information available through the Energy Information Administration (EIA).[23] However, for several reasons, I exclude the Texas shale

[22] All U.S. Banks are required to file quarterly Call Reports with bank regulators. The auditor is identified in the year end holding company report (FR Y-9C) for all bank holding companies. Call Report and FR Y-9C data is publicly available through the FDIC.
[23] I used the county-level shale production data from eia.gov to identify the specific counties identified as being part of a shale region.

regions from my analyses.[24] Figure 1 shows a map of each shale region along with the year that significant fracking activity commenced within each region. As depicted in Figure 2, I identify the following 11 shale play states: MT, ND, WY, NE, CO, OK, AR, LA, OH, PA, and WV.[25]

Using the Allcott and Keniston measure of oil and natural gas endowment as discussed in section 3.1.1 and APPENDIX A, I calculate both a continuous and dichotomous measure of a bank's exposure to the shale boom. I calculate a continuous measure of bank exposure (*Exposure*) as the proportion of a bank's branches located in highly endowed counties. For the dichotomous measure (*Exposed*), banks with any branches in high-endowment counties are identified by the indicator variable *Exposed*. For the analysis using *Exposed*, the banks with branches in play states, but without branches located in counties with high levels (i.e., above the median) of oil and natural gas endowment are used as control banks. Figure 2 depicts the treatment and control counties used in this analysis.

I remove all observations with missing data for key variables, as well as observations with zero or negative assets. This results in an unbalanced panel of 11,178 bank years for the analysis of H1. Table 1, Panel B shows the calculation of the sample for the test of H2. For a portion of

[24] Significant fracking activity began in the Permian region in 2005 (West Texas), and experimentation in the region began before that date. Due to limitations on the availability of auditor information prior to 2005, I do not have sufficient observations prior to the onset of the boom period to conduct a difference-in-differences analysis. Additionally, there are two different dates for the commencement of significant fracking in shale plays within Texas and there was also significant conventional oil activity in Texas prior to the onset of the fracking boom. This complicates the establishment of pre and post dates for the control counties. Thus, I exclude all banks with the majority of their branches located in Texas from my sample. See section 5 for detailed discussion of an additional analysis completed using a methodology to allow the inclusion of Texas, which suggests that my results are robust to the inclusion of Texas. I consider the difference-in-difference methodology to provide the strongest identification in my setting, thus the primary analysis is conducted using the approach outlined in section 3 and excluding Texas.

[25] New York is located within the Marcellus Region according to the EIA; however, I exclude New York from the sample for two primary reasons, 1) The state passed a ban on hydraulic fracking, which limited shale development in the state and 2) the concentration of significant national banking activity in New York City makes banks in non-Endowed New York Counties an inappropriate control group for the purposes of the analysis. The primary results are robust to inclusion of New York in the analysis.

Figure 1
Major U.S. Shale Play Regions

This figure depicts the eight major U.S. shale play regions with significant fracking activity during 2005-2014. Play counties are identified by the Energy Information Administration (EIA). Years indicate the first year of major fracking activity in the region. The date of fracking activity commencement was established based on prior research (Bartik et al. 2016; Erik P. Gilje et al. 2016) and validated based on review of production and leasing activity. Note: Texas, New York, and New Mexico shale play counties are excluded from the analysis.

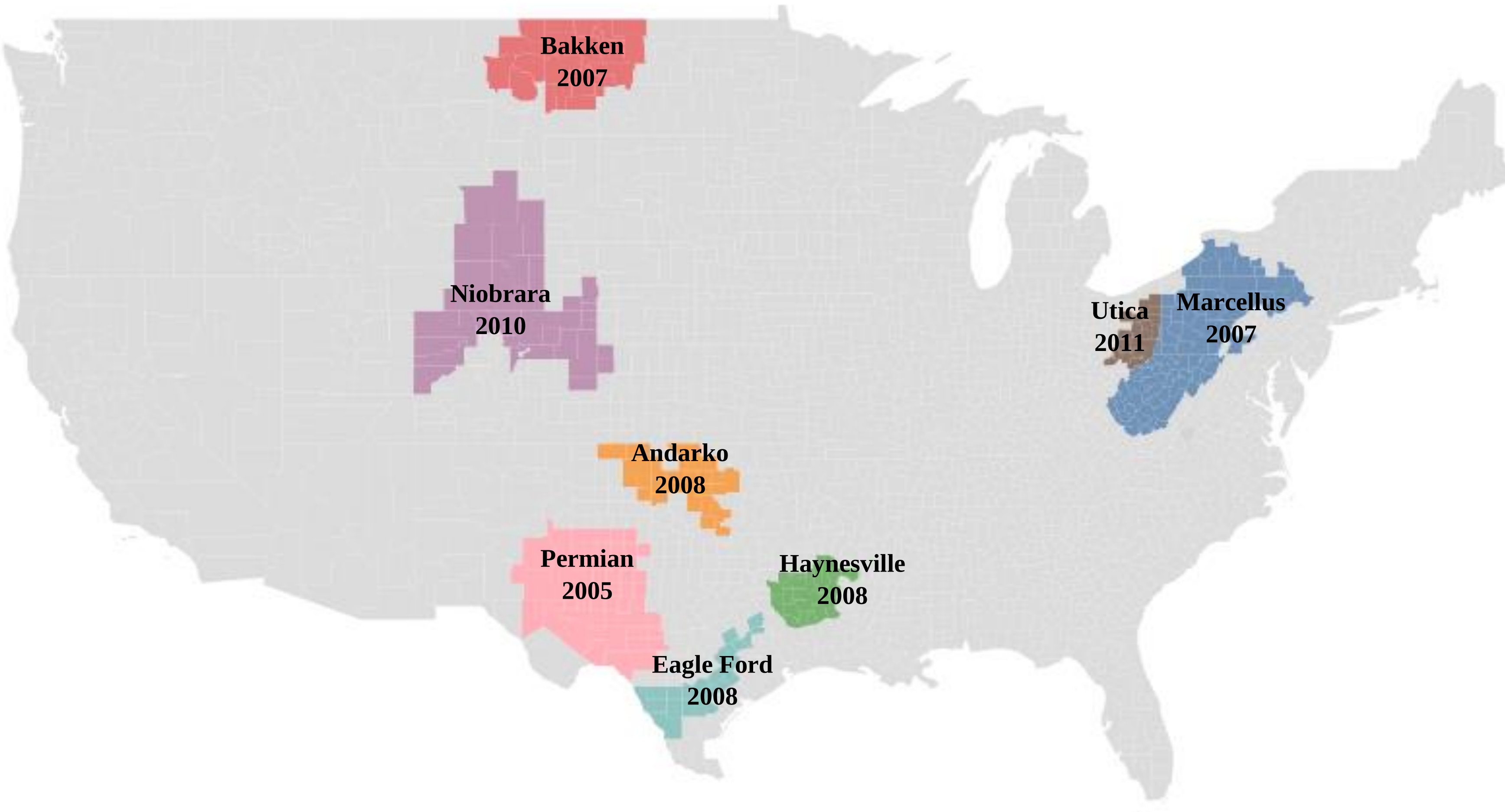
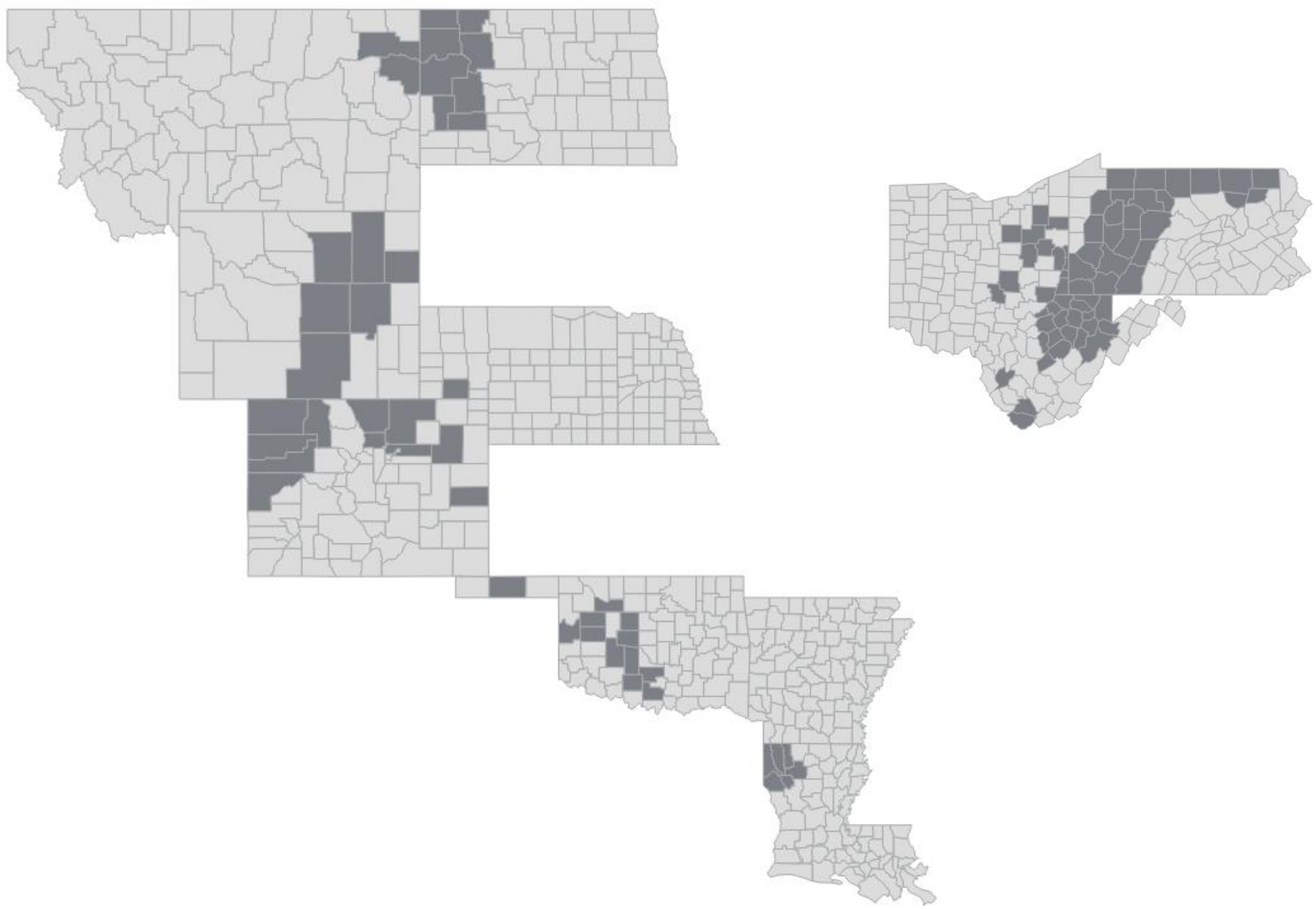


Figure 2

Treatment and Control Counties within Shale Play States

This figure depicts the treatment and control counties used to identify *Exposed* banks (*Exposed* = 1) for the primary analysis. Light grey counties are below the median in *Endowment* for the play region. Dark grey counties are above the median in of *Endowment*. Banks with the majority of branches in dark grey counties are identified as exposed banks, while banks with the majority of their branches in the light grey counties are identified as control banks. *Exposure* is the proportion of a bank's branches located in dark grey counties.



the analysis comparing audited to unaudited banks, I limit the sample to banks with less than $500 million in assets, resulting in a sample of 9,296 bank years. For the analysis of the effect of auditor expertise, I limit the sample to audited banks, resulting in a total of 5,837 bank years.

4.2. Descriptive Statistics

Table 2, panel A presents descriptive statistics for the sample of banks used to test H1. The sample includes 11,178 bank years with a mean (median) loan portfolio size of $2.7 billion ($0.93 billion) and deposits of $3.3 billion ($1.2 billion). The mean (median) CO/ALL Ratio (*ALL Quality*) is 0.184 (0.111 percent). The relatively low CO/ALL ratio is consistent with banks being over-reserved, as discussed in chapter 3.2.1. Regarding auditor characteristics, 52.2 percent of bank years are audited, 5.9 percent are audited by Big 4 auditors (*Big4*), and 10.8 percent are audited by an industry expert auditor (*IndExpert*).[26]

Table 2, panel B presents descriptive statistics for subsamples of exposed and non-exposed banks. Within the subsample of exposed banks, the mean (median) exposure is 0.65 (0.75). On average, the exposed banks are larger compared to non-exposed banks due to larger banks generally having a larger number of branches, which increases the likelihood of a bank being in a high endowment county. The size discrepancy between the exposed and non-exposed banks presents a potential concern given that large banks may fundamentally differ from small banks. I address this concern in robustness tests by 1) excluding large banks, and 2) utilizing an alternative identification strategy.[27] Table 3 presents a correlation matrix showing the pairwise

[26] In the subsample of audited banks, 11.2 percent are audited by Big 4 auditors, 42.0 percent are audited by auditors with previous experience, and 20.7 percent are audited by industry experts.
[27] Chapter 5 describes the procedure to address concerns regarding bank size differences between exposed and non-exposed banks. Specifically, I limit the sample to only those banks under $500 million in assets and document qualitatively similar results. Also see chapter 5 for details of the broad sample analysis using an alternative identification strategy and a shift-share approach.

correlation of key variables. As expected, there is a significantly negative correlation between *ALL Quality* and post-boom *Exposure* (-0.030).

4.3. Results

4.3.1 Hypothesis 1: Effect of a positive economic shock on ALL quality

Table 4 presents the results of estimating model (1) to test H1. The results using a continuous measure of exposure are presented in column (1). The primary coefficient of interest is the coefficient on *Post*Exposure*, which measures the marginal impact of exposure to the shale boom on ALL quality. I find a negative and significant coefficient on *Post*Exposure* (β_3 = -0.032, p-value < 0.05). This indicates that ALL quality is 11.2 percent lower for a bank with a mean CO/ALL ratio (0.184) at the mean level of exposure for an exposed bank (0.645) compared to a non-exposed bank following the onset of the shale boom.[28] The coefficient on *Exposure* is insignificant (p-value > 0.10), indicating that ALL quality is not significantly associated with *Exposure* prior to the onset of the boom, which supports the appropriateness of the control sample. Figure 3, panel A presents a graphical time-series representation of the effect of *Exposure* relative to non-exposed banks during the sample period. There is no significant difference in ALL quality prior to the onset of the boom (i.e., *t-3* to *t-1*); however, after the onset of the boom, ALL quality is negatively related to *Exposure*, supporting the conclusion that the onset of the shale boom had a negative effect on ALL quality.

Table 4, column (2) presents the results of estimating model (1) using the dichotomous measure of *Exposed* to identify banks with any branches in counties where *Endowed* = 1. Consistent with the results in column (1), I find a negative and significant coefficient on

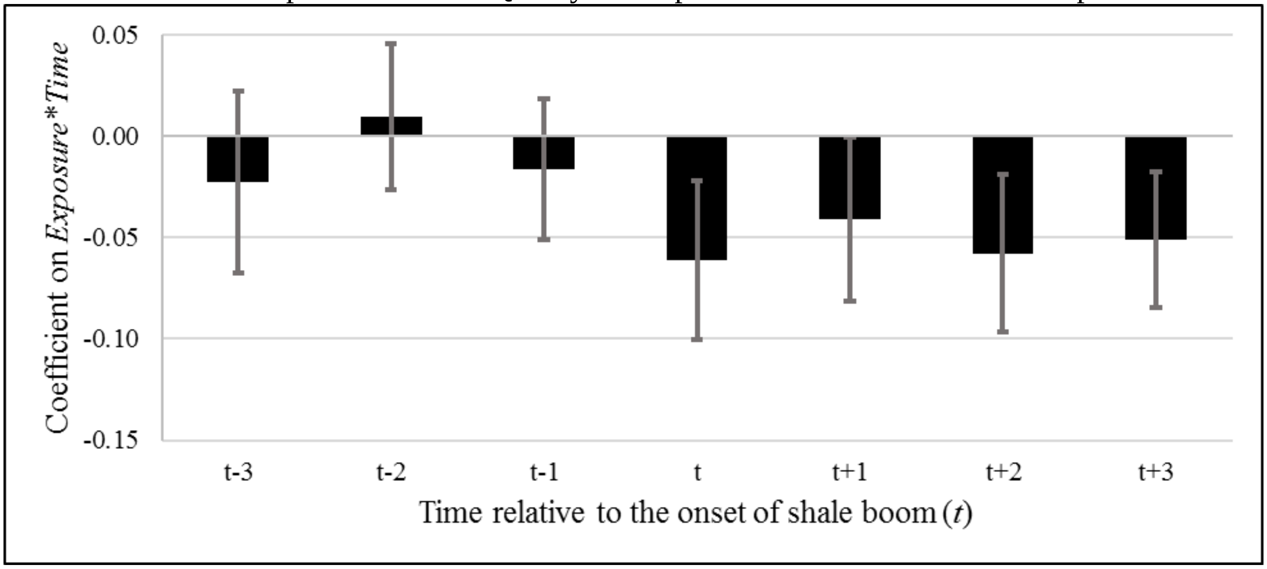
[28] (-0.032*0.645)/(0.184).

Figure 3

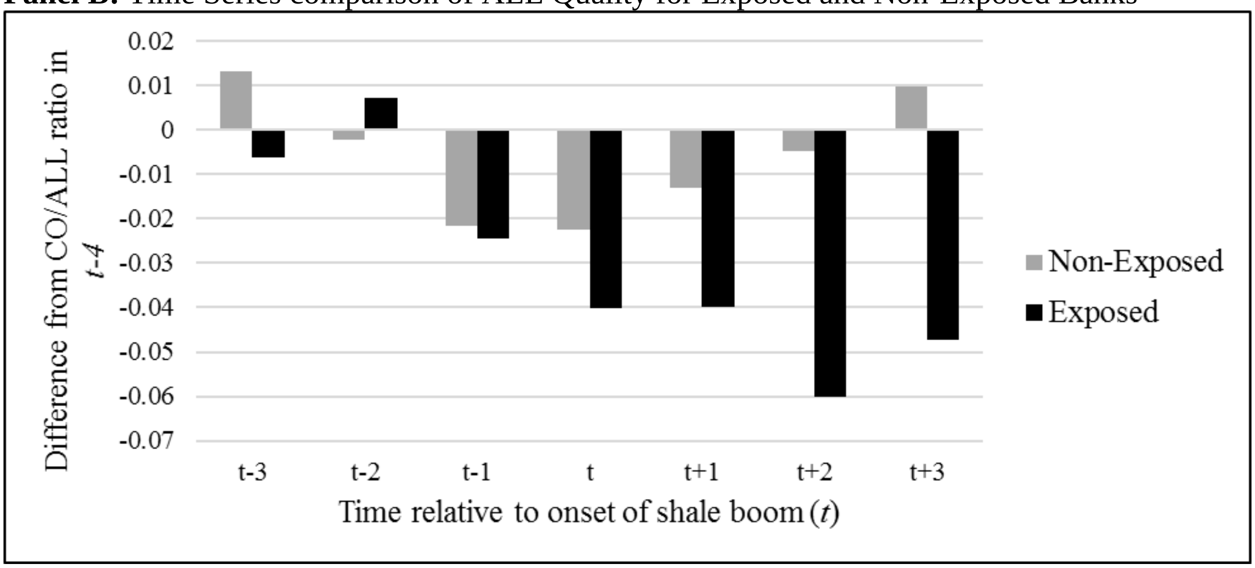
Time Series Analysis of ALL Quality

Panel A presents a graph of the coefficients on *Exposure*Time* for a regression of *ALL Quality* on indicator variables for the time relative to onset of the shale boom and an interaction of the indicator variables with *Exposure.* The black bars represent the effect of Exposure on ALL quality for exposed banks relative to non-exposed banks during the sample period. The 90% confidence intervals are shown in grey. Panel B presents a graph of a the coefficient on a time indicator variable, defined relative to the onset of the boom (t), in estimating a regression of ALL quality on time indicators and control variables consistent with model (1) separately for Exposed banks (black bars) and non-Exposed banks (grey bars). In both panels, *t* is the first year that bank *i* is impacted by significant shale boom activity (i.e., *t* = 1 in the first year *Post* = 1). *ALL Quality* in *t-4* is used as the base period for comparison. Coefficients are estimated using control variables consistent with model (1).

Panel A: Effect of Exposure on ALL Quality for Exposed Banks relative to non-Exposed Banks



Panel B: Time Series comparison of ALL Quality for Exposed and Non-Exposed Banks



*Post*Exposed* (β_3 = -0.024, p-value < 0.05), indicating that ALL quality for exposed banks is 13.6 percent lower compared to non-exposed banks following the onset of the shale boom, for banks at the mean level of CO/ALL ratio and *Exposure*. Figure 3, panel B presents a time series comparison of ALL quality separately for exposed and non-exposed banks, where *t* is the first year of shale boom activity (i.e., first year *Post* = 1). There is no significant difference in ALL quality between the base period (*t-4*) and periods *t-3*, *t-2*, and *t-1* for either exposed or non-exposed banks. However, beginning in year *t*, ALL quality for exposed banks is significantly lower compared to the base period. There is no significant difference in ALL quality compared to the base period for non-exposed banks in any year during the sample period.

As discussed in chapter 3, I exclude all observations where the bank was not over-reserved (i.e., $CO_{t+1}/ALL_t > 0$). As a robustness test, I estimate model (1) without excluding the over-reserved banks. Table 5 presents the results of this analysis and shows the coefficient on *Post*Exposure* is negative and significant (p-value < 0.05) for both the continuous and dichotomous measures of exposure, which is consistent with the primary findings in Table 4.

4.3.1.1 Additional Analysis of ALL and Charge-Offs

The lower ratio of charge-offs in *t+1* to ALL in *t* identified in banks with higher exposure compared to less exposed banks can result from banks 1) experiencing a change in charge-offs and failing to change the ALL estimate, 2) changing the ALL estimate and not experiencing a change in charge-offs, or 3) changing the ALL estimate in a manner that does not correspond with the change in charge-offs experienced. To further explore these possibilities, I estimate model (1) by replacing the dependent variable of CO/ALL first with the log of one plus charge-offs (*CO Level*), second with the log of one plus ALL (*ALL Level*). Table 6, column (1) presents the results of estimating model (1) using *CO Level* as the dependent variable and shows the coefficient on *Post*Exposure* is negative and significant (β_3 = -0.306, p-value < 0.01), indicating that following the onset of the shale boom, an exposed bank with the mean level of *Exposure* experiences 19.8 percent less charge-offs compared to non-exposed banks.[29] The lower level of charge-offs is consistent with an overall improvement in economic environment that accompanies a shale boom having a positive effect on both the ability of borrowers to service loans as well on the value of loan collateral. Column (2) shows the coefficient on *Post*Exposure* when estimating a model with *ALL Level* as the dependent variable is insignificant (p-value > 0.10), indicating that the ALL level does not differ based on a bank's exposure to the shale boom. Together, these findings indicate that banks with higher exposure to shale booms experience decreases in charge-offs, but do not adjust the ALL estimate to appropriately capture these decreases, indicating an under-reaction to the shale boom.

Figure 4 shows the time trend in ALL levels and CO levels relative to the onset of the shale boom for exposed banks, relative to non-exposed banks. In the three years prior to the onset of the shale boom both CO and ALL levels are higher compared to the base period (*t-4*); however, in years *t*, *t+1* and *t+2*, CO levels are significantly lower compared to the base period, while ALL levels remain similar. These findings are consistent with exposed banks experiencing a reduction in charge-offs following the onset of the shale boom, and under-reacting to the shock by failing to adjust the ALL to account for the change in the economic environment.

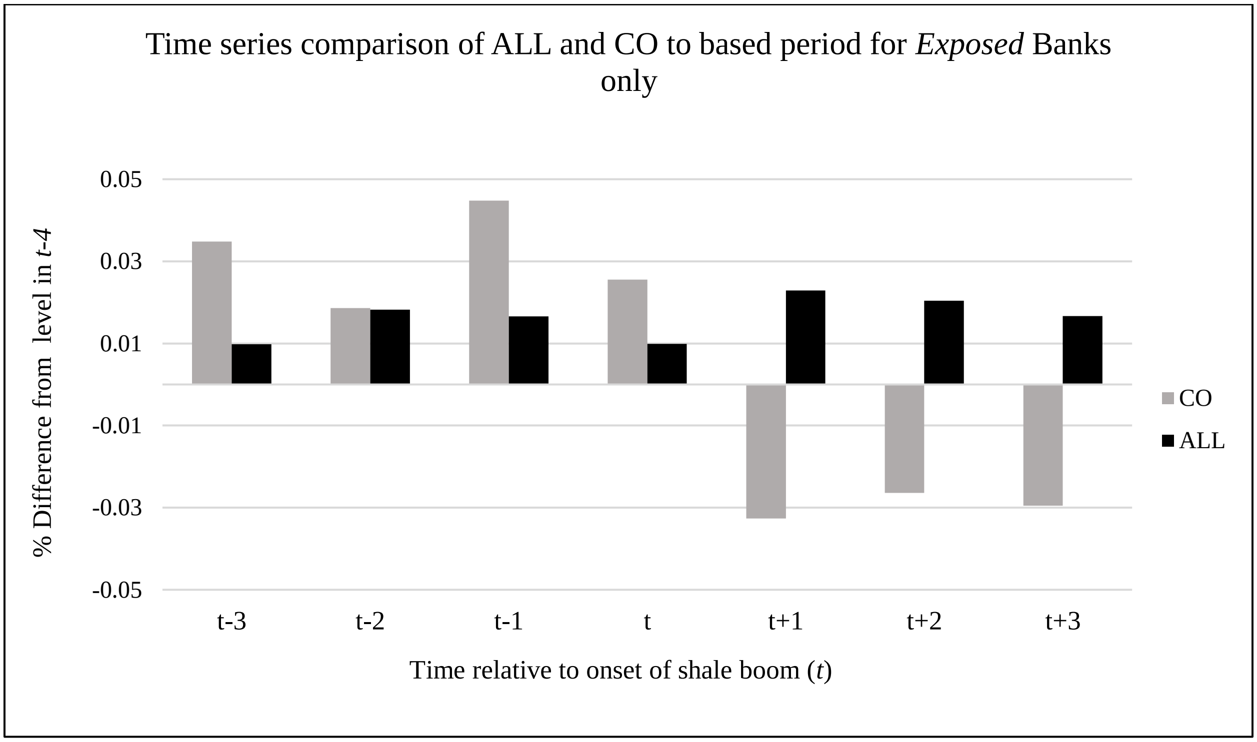
There are two non-mutually exclusive explanations for the failure to appropriately adjust the ALL for the change in charge-off levels. The first is an over-reliance on historical charge-off

[29] (-0.307*0.645) = -0.198

Figure 4

Time Series Analysis of ALL and CO levels of Exposed Banks

This figure presents a graph of the coefficients on *Exposed*Time* for regressions of *ALL Level* and *CO Level* on indicator variables for the time relative to onset of the shale boom and an interaction of the time indicator variables with *Exposed*. *T* is the first year that bank *i* is impacted by significant shale boom activity (i.e., *t* = 1 in the first year *Post* = 1). ALL and CO levels in year *t-4* are used as the base period for comparison. Coefficients are estimated using control variables consistent with model (1).



information without making necessary qualitative adjustments for the change in the economic environment compared to the historical period. This explanation is consistent with Tversky and Kahneman (1974)'s theory suggesting insufficient adjustment leading to bias under uncertainty. The second explanation is intentional management manipulation to build a "cookie jar" reserve during economic boom times that will allow for earnings smoothing in times of economic downturn. I further explore these explanations in chapter 4.3.1.2.

Overall, the results of the test of H1 indicate that exposure to a positive economic shock results in lower ALL quality relative to banks not exposed to the shock. These findings are consistent with the uncertainty associated with periods of rapid growth increasing the difficulty of developing accounting estimates, and with management under-reacting to positive economic shocks.

4.3.1.2 Additional Analysis of bank resource constraint and portfolio composition

The identified lower financial reporting quality following exposure to the shale boom can result from two, non-mutually exclusive channels: 1) higher difficulty in developing ALL estimates due to increased uncertainty, and 2) intentional management bias. Conversations with both auditors and bank management exposed to the shale boom indicate that a combination of the two is the most likely explanation. As discussed in chapter 2, there is an increased uncertainty surrounding future cash flows from loans. There is also a significant change in the economic environment, which affects a bank's existing loan portfolio and limits the reliability of historical charge-off information. The result is an increased need for appropriate qualitative adjustments to historical charge-off numbers in the development of the ALL. Development of the qualitative factors is inherently difficult and relies heavily on management judgement. This increased reliance on management judgement provides bank management with the opportunity to develop “cookie-jar reserves” by adding excess reserves resulting in a conservative bias in the loan loss. The excess reserves can be released at a future time, inflating earnings in a future period. This results in earnings smoothing, consistent with the pattern identified by Liu and Ryan (2006).

In additional analysis, I attempt to determine whether one of the two channels dominates. If the primary channel is the challenge of compiling and analyzing the information necessary to develop a higher quality ALL, banks with greater resource constraints in terms of human resource capacity would be expected to be more significantly affected compared to banks with lesser HR constraints. I use the ratio of bank full-time employees to total assets as a proxy for human resource availability. I define the variable *HR_Constrain* as an indicator variable equal to 1 if a bank is below the sample median in the ratio of full-time employees to total assets, and zero otherwise. I separately estimate model (1) for banks with above and below median ratio of full-time employees to assets.[30] Table 7, panel A, column (1) shows a negative and significant (p-value < 0.05) coefficient on *Post*Exposure* for the subsample where *HR_Constrain* = 0, while the coefficient is negative and insignificant (p-value > 0.10) for the subsample where *HR_Constrain* = 1. However, panel B shows that in a chi-squared test, there is no significant difference in the coefficient across the two subsamples. Thus, the analysis provides weak or no evidence that the effect of the shale boom is concentrated in those banks with less resource constraints. The finding is not consistent with bank resource constraint resulting in more significant impact of the shale boom.[31]

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[30] The findings are unchanged if total employees is scaled by gross loans rather than total assets.
[31] I acknowledge that the proxy for resource constraint is noisy, given that it is based on total employee headcount. However, due to data limitations, the count of employees associated specifically with the loan function is not available, thus the total employee to asset count is the best available proxy.

Loan portfolios that are more heterogeneous present a greater challenge to bank management in terms of developing the ALL, as a broader knowledge of the effect of an economic shock on different types of loans is required. Thus, if the difficulty of developing the ALL is the primary reason for lower ALL quality following exposure to the shale boom, I predict that those banks with a more heterogeneous or higher-risk loan portfolio prior to the onset of the boom would exhibit significantly greater deterioration in ALL quality compared to the more homogenous or lower-risk loan portfolios. I measure portfolio risk by multiplying the average charge-offs by loan types for all U.S. banks from 1992-2016 by the proportion of loans of a particular type in the bank's portfolio. The resulting measure is a weighted average of risk for the bank based on historical charge-offs across all banks. I define *High_Risk* as an indicator variable equal to 1 if a bank's portfolio risk is above the sample median, and zero otherwise. Consistent with Acharya et al. (2006), I capture portfolio concentration using the Hirschman Herfindahl index (HHI) measure.[32] I define *Diverse_Port* as an indicator variable equal to 1 if a bank is below the sample median in portfolio diversification and zero otherwise. In order to have a clean measure of *ex ante* risk and concentration prior to the onset of the boom, I measure both loan portfolio risk and concentration as of 2007. Consistent with the test of the effect of human resource availability, I split the sample at the median of loan risk and loan concentration and estimate model (1) for each subsample.

Table 8, panel A shows a negative and marginally significant (p-value < 0.10) coefficient on *Post*Exposure* for the lower risk banks in column (1) and for banks with a more homogenous loan portfolio in column (3). In contrast, the coefficients on *Post*Exposure* for the higher risk

[32] (Acharya et al. 2006) focus on loan concentration based on industry, using a unique single-country (Italy) dataset. Due to limitations on availability of industry-level loan data for the sample, I focus instead on loan type based on FDIC Call Reporting Codes. I consider this to be a reasonable level of analysis for loan concentration as it mirrors the loan type breakdown evaluated by regulators.

(column 2) and more heterogeneous loan portfolios (column 4) are negative and insignificant (p-value > 0.10). However; panel B shows no significant difference in the coefficients across the either of the loan portfolio composition splits. Thus, overall this analysis does not provide evidence of a significant difference in the effect of the boom based on loan portfolio composition.

Based on these additional analyses, it is not possible to definitively say that the effect of the shale boom is primarily driven by either the difficulty of developing the loan loss estimate or by management bias. While this could be due to the challenge of identifying a noise-free proxy for portfolio risk or resource constraint, it also points to the explanation that a combination of both channels is responsible for the results of the primary analysis.

4.3.2 Hypothesis 2: Effect of the auditor on ALL quality during a positive economic shock

I test the effect of the auditor on ALL quality following exposure to a fracking shock by first comparing subsamples of audited and unaudited banks. Table 9, panel A columns (1) and (2) present the results of estimating model (1) separately for each subsample, and panel B presents the results of a χ^2 test of difference on the coefficient of interest (*Post*Exposure*) across the subsamples. I find that the coefficient on *Post*Exposure* is negative and insignificant (p-value > 0.10) for unaudited banks and negative and marginally significant (p-value < 0.10) for audited banks. Panel B, column (1) shows that there is no significant difference in the coefficient on *Post*Exposure* between audited and unaudited banks, indicating the effect of *Exposure* on ALL quality following the shale boom does not differ based on presence of an auditor. The lack of significant difference in coefficients across these subgroups suggests that an auditor alone does not mitigate the lower ALL quality associated with the boom compared to non-expert auditors. This finding is consistent with auditors, on average, not appropriately adjusting their risk assessment and audit procedures to changes in the economic environment of their clients due to the shale boom.

I then examine the effect of general auditor expertise due to access to greater firm resources within a subsample of audited banks. Table 9, panel A, columns (3) and (4) present the results of estimating model (1) for subsamples of banks audited by non-Big 4 and Big 4 auditors respectively, limiting the sample to audited banks. The coefficient on *Post*Exposure* is negative but insignificant (p-value > 0.10) for the both subsamples. Panel B shows there is no significant difference in the coefficient on *Post*Exposure* across the regressions, indicating that the effect of the exposure to the shale boom does not differ based on the presence of a Big 4 auditor. This result suggests that the general expertise of Big 4 auditors does not significantly mitigate the effect of the shale boom on ALL quality compared to non-Big 4 auditors.

While I do not find evidence that the presence of an auditor in general is associated with higher ALL quality during a boom period compared to non-audited banks, there is an extensive literature that suggests that Big 4 and industry expert auditors perform higher-quality audits compared to non-expert auditors (DeFond and Zhang 2014). Thus, it is possible that banks audited by a Big 4 or industry expert auditor may have higher ALL quality following a shale boom compared to *unaudited* banks. Table 11 presents an analysis of banks audited by Big 4 and industry expert auditors compared to unaudited banks, and in this analysis I do find evidence that auditors with expertise are associated with less deterioration in ALL quality following exposure to the shale boom compared to unaudited banks. This result suggests that there is variation in the effects of ALL quality based on auditor expertise within audited banks and supports the analysis of auditor expertise within the subsample of audited banks.

Next, I examine the effect of industry expertise on ALL quality following exposure to a shale boom. Table 10, panel A, columns (1) and (2) present the results of estimating model (1) for subsamples of banks audited by non-industry expert and industry expert auditors respectively. In column (1), the coefficient on *Post*Exposure* is negative and significant (β_3 = -0.047; p-value < 0.05) for the subsample of banks audited by non-experts, which is consistent with a negative relationship between *Exposure* and ALL quality following the onset of a shale boom. In contrast, column (2) shows a positive, although insignificant coefficient on *Post*Exposure* (β_3 = 0.046; p-value > 0.10) for the subsample of banks audited by industry experts, indicating that *Exposure* is positively related to ALL quality for clients of industry experts following the onset of the shale boom. Panel B, column (1) shows the coefficient on *Post*Exposure* is significantly different across the regressions (Difference= 0.116; p-value < 0.05), indicating that industry expertise is associated with significantly higher ALL quality for exposed banks following the shale boom relative to banks audited by non-industry experts. These results indicate that industry expertise is effective at mitigating deterioration in ALL quality following exposure to a shale boom.

Next, I examine the effect of task-specific expertise on ALL quality following exposure to a shale boom. Table 10, panel A, columns (3) and (4) present the results of estimating model (1) for subsamples of banks audited by non-task-specific expert and task-specific expert auditors respectively. In column (3), the coefficient on *Post*Exposure* is negative and significant (β_3 = -0.060; p-value < 0.05) for the subsample of banks audited by non-task-specific experts, and column (4) shows the coefficient on *Post*Exposure* is negative and insignificant (β_3 = -0.038; p-value > 0.10) for the subsample of banks audited by task-specific experts. Panel B, column (2) shows the coefficient on *Post*Exposure* is significantly higher (Difference = 0.022; p-value <

0.10) for clients of task-specific experts, indicating that task-specific expertise is associated with higher ALL quality for exposed banks following the shale boom relative to banks audited by non-task-specific experts. The results provide some support for the effectiveness of task-specific expertise at mitigating deterioration in ALL quality during a shale boom.

In the sample, there is overlap in the auditors that have industry and task-specific expertise. In total, 63 percent of auditors with industry expertise also have task-specific expertise and 31 percent of auditors with task-specific expertise also have industry expertise. The overlap makes it challenging to determine whether it is industry expertise, task-specific expertise, or a combination of the two that is responsible for mitigating deterioration in financial reporting quality following the shale boom. To disentangle the effects of industry and task-specific expertise, I estimate model (1) for each of the following three subsamples: 1) clients of auditors with neither industry, nor task-specific expertise, 2) clients of auditors with either industry, or task-specific expertise (i.e., single expertise), and 2) clients of auditors with both industry and task specific expertise (i.e., combination expertise). I compare the coefficients on *Post*Exposure* across the subsample regressions. Table 12, panel A, columns (1) and (2) present the results of estimating model (1) for clients of an auditor with neither industry nor task-specific expertise. Consistent with the test of H1, the coefficient on *Post*Exposure* is negative and significant (β_3 = -0.053; p-value < 0.05). Column (2) presents the results for the subsample of banks audited by an auditor with either industry or task-specific expertise (but not both) and the coefficient on *Post*Exposure* is negative and statistically insignificant (β_3 = -0.070; p-value > 0.10); and the magnitude of the coefficient is greater than the coefficient on *Post*Exposure* for the subsample in column (1). Panel B, column (1) shows that the differences in the coefficient between the two regressions is marginally significant, suggesting greater deterioration in financial reporting quality in banks audited by auditors with either industry or task-specific expertise (but not both) compared to banks audited by auditors with neither type of expertise. A potential explanation for this result is that auditors without the necessary industry background to understand how changes in the economic environment affect the ALL, or without the experience to understand the changes, may encourage clients to be more conservative in their ALL estimates as uncertainty increases and the auditors observe their other exposed clients moving in a more conservative direction. In contrast, the coefficient on *Post*Exposure* for clients of auditors with both industry and task-specific expertise is insignificant ($\beta_3 = 0.106$; p-value > 0.10), indicating that auditors with a combination of industry and task-specific expertise effectively mitigate deterioration in financial reporting quality following a shale boom. Panel B, column (2) shows the coefficient is significantly higher for banks audited by dual-experts compared to the regression estimate for banks audited by an auditor with only a single expertise. Taken together, the results indicate that industry expertise or task-specific expertise alone is insufficient to mitigate lower ALL quality resulting from exposure to shale booms. Instead, it is the *combination* of industry and specific expertise that is effective in mitigating the effect of exposure.

In an additional analysis presented in Table 13, I separately examine only industry expertise and only specific expertise and find that neither expertise alone is associated with significantly higher ALL quality compared to banks audited by non-experts following the onset of the shale boom. I find that specific expertise alone is associated with lower quality ALL following the onset of the fracking boom, compared to the ALL quality of banks audited by a non-expert. These findings are consistent with single expertise alone being insufficient to mitigate the lower ALL quality following exposure to a fracking boom. These findings are consistent with behavioral research and theory (e.g., Bonner 1990; Bonner and Lewis 1990;

Arrow 1962) suggesting that learning by doing is an important component of expertise; however, the results also indicate it is necessary for auditors to have industry-level knowledge in order to appropriately learn from and adjust their audit approach based on specific experiences following a positive economic shock.

In an additional analysis, I also compare the effect of a combination of industry and task-specific expertise to Big 4 expertise, as Big 4 auditors are commonly accepted as experts in prior literature (e.g., DeFond and Zhang 2014). In Table 14, I find that a combination of industry and task-specific of non-Big 4 auditors is significantly more effective at mitigating deterioration in financial reporting quality compared to Big 4 expertise. This result underscores the finding that a fit between the auditor expertise and client's economic challenges is critical to the effectiveness of auditor expertise and suggests that high-level generic proxies may not capture auditor expertise in all circumstances.

CHAPTER 5: SUPPLEMENTAL ANALYSIS AND ROBUSTNESS

5.1. Broad Sample Analysis: Shift-share approach

One of the potential limitations of the research design for the main analyses of this paper is that it requires an arbitrary cutoff point for a county to be considered highly endowed (i.e., above the median), as well as the identification of the specific year when the shale boom began in each shale play. Furthermore, to establish a clear treatment and control group, I limit the sample to only banks operating in play states, as described in chapter 3.1.1 and APPENDIX A. In order to address concerns that these research design choices significantly influence the findings, I use an alternative empirical strategy inspired by the Bartik (1991) “shift-share” approach (Allcott and Keniston 2018). In this approach, the independent variable of interest is an interaction between a standardized measure of a bank’s oil and gas endowment (*BankEndowment*) based on its branch locations and national time series variation in active horizontal drilling rigs (*ΔRigs*). Horizontal drilling is a key first stage in the fracking process; thus, the national level of active horizontal drilling rigs is an indicator of the intensity of start-up fracking activity. Specifically, from 2005 to the height of shale-boom activity in 2014, the count of horizontal drilling rigs increased by more than 500 percent, from 222 to 1,372. The average increase year over year was 22 percent during the same period. Horizontal drilling activity covaries with *BankEndowment*, in that the impact of an increase in number of horizontal drilling rigs should be positively related with the availability of oil and natural gas within a bank’s geographic footprint. Because the Allcott and Keniston endowment measure covers nearly all counties in the United States, I can include all bank-year observations in the sample, rather than limiting the sample to only banks with branches located in play states. Using the expanded sample, I estimate the following model:

$$\Delta ALL\ Quality_{it} = \gamma_1 BankEndowment_{ist} + \boldsymbol{\gamma_2 \Delta Rigs*BankEndowment_{ist}} + \gamma \Sigma \Delta Controls_{ist} + e_{ist} \quad (2)$$

The model includes the first difference of control variables and logged percentage change in *ALL Quality* and is estimated with year and state fixed effects.[33] *BankEndowment* is a standardized continuous measure calculated as a weighted average of a bank's exposure to oil and natural gas deposits, and *ΔRigs* is the log percentage change in the number of horizontal drilling rigs.[34] Table 15 presents the results of the shift-share analysis. The coefficient on *ΔRigs*BankEndowment* is negative and significant (γ_2 = - 0.067, p-value < 0.05), indicating that for each standard deviation increase in bank endowment, a one percentage increase in rig count reduces the ALL quality by 6.7 percent. This result is consistent with the results of the main analysis and provides support for H1 using a broader sample of bank-year observations. The insignificant coefficient on *BankEndowment* indicates that trends in ALL quality changes do not significantly vary based on a bank's endowment, providing further support for the strength of the identification strategy.

5.2 Identifying assumptions and robustness

5.2.1 Parallel trends assumption and falsification test

The key assumption of the difference-in-differences methodological approach is the zero correlation assumption, commonly referred to as the "parallel trends" assumption (Roberts and

[33] The main effect of Δ*Rigs* is subsumed by year fixed effects.
[34] *BankEndowment* is calculated as the proportion of a bank's branches located in county c, multiplied by the continuous measure of Endowment in county c, and summed by bank. *BankEndowment* is standardized by subtracting the sample mean of *BankEndowment* and dividing by the sample standard deviation. The standardization of the variable aids in interpretation.

Whited 2013). This assumption requires that trends are the same on average for the treatment and control groups in absence of treatment. Although the assumption cannot be explicitly tested, there are several analyses that can aid in mitigating concerns that different trends confound the results. I first analyze the reasonableness of the parallel trends assumption by graphically comparing the trends prior to the treatment period. Figure 3, panel A demonstrates that there is no significant difference in the ALL quality for the years prior to exposure and there is no indication of divergent trends between the two groups. Furthermore, Figure 3, panel B shows that there is not a significantly divergent trend in ALL quality between exposed and non-exposed banks prior to the onset of the boom. Together these figures provide support for the parallel trends assumption.

Following Roberts and Whited (2013), I also conduct a falsification test. For the falsification test, I estimate model (1) by replacing the *Post* variable with *Post_False*, an indicator equal to 1 for the three years prior to the onset of the shale boom (i.e., *Post* = 1 in year *t-3*) and exclude all post-period observations (i.e., year = *t* and subsequent years). Table 16, column (1) presents the results of the falsification test and shows the coefficient on *Post_False*Exposure* is negative and insignificant (p-value > 0.10). Additionally, I conduct the falsification test without excluding post-period observations. As shown in Table 16, column (2), I continue to find that the coefficient on *Post_False*Exposure* is insignificant (p-value > 0.10). These findings are consistent with expectations for the falsification test and provides further support for the difference-in-differences findings.

I acknowledge that there are likely spillover effects of a fracking boom due to the flow of money, jobs, and people across county lines. However, the use of a within-state control group biases against finding results in the presence of a significant spillover effect. To further address this concern, I also use an alternative identification methodology in the shift-share analysis discussed in section 5.1, which provides further assurance that the specific research design decisions in identifying the treatment and control group do not drive the results. Due to the likelihood of spillover effects across county lines, it is unlikely that only the high-endowment counties were affected by fracking shocks; however, the supplemental analyses provides confidence that the results are not sensitive to the precise definition of treatment and control groups. Furthermore, any spillover should bias against finding results.[35]

5.2.2. Endowment measure exogeneity

Although the location of a bank or audit firm over a shale play is not directly chosen, it is possible that banks located in counties with high levels of oil and natural gas endowment differ from banks in counties with lower levels of endowment, even within the same state. If this is the case, then characteristics of banks other than the exposure to the disruptive resource boom could drive differences in audit and financial reporting quality. To address this concern, I test the correlation of the endowment measure with various characteristics of the counties that may potentially affect financial reporting quality prior to the onset of the oil boom (*Post* = 0). The purpose of this test is to examine whether endowment can be reasonably considered "random" as required by a quasi-experiment, or if additional empirical strategies are needed to address initial assignment. I examine the correlation between size, deposit growth, charge-offs, non-performing loans/asset levels and loan growth and I estimate the correlation by separately regressing each

[35] According to Glaeser and Guay (2017), perfect compliance "is the assumption that no firms received the treatment in the pre-treatment period and that all firms in the treatment group—and only those firms—received the treatment in the post treatment period." The stable unit value treatment assumption "requires the treatment status of the treated group does not affect outcomes of the control population and vice versa" (Glaeser and Guay 2017). The supplemental analyses performed mitigate concerns related to potential violations of these assumptions.

characteristic of interest on a continuous measure of share of bank branches located in highly-endowed counties in 2007 ($Exposure2007_i$). Consistent with the main analyses, I estimate each relation using state and year fixed effects and cluster standard errors by bank. Table 17 presents results showing no significant correlation (p-value>0.10) between $Exposure2007_i$ counties and bank characteristics of interest. The results provide confidence that the *Exposure* measure is uncorrelated with bank characteristics that may explain the results and provides evidence of the exogeneity of the exposure measure.[36]

While this analysis shows no significant correlation between size and the *Exposure* measure, Table 2 shows that there is a size discrepancy between the subgroups of exposed and non-exposed banks. To address concerns that size differences may influence results, I reperform the primary analysis using a sample of only banks with assets less than $500 million. Consistent with the primary results, Table 18 shows a negative and significant coefficient on the interaction of *Post* with both the continuous and dichotomous measures of exposure (β_3 = -0.027, p-value <0.10; and β_3 = -0.027, p-value < 0.05). The limited sample removes the large banks which drive the size discrepancy between the two groups and mitigates concerns that size differences between exposed and non-exposed banks explain the results. Furthermore, the shift-share analysis described in section 5.1 utilizes a first-differencing estimation method, which further mitigate concerns that correlation between bank-level characteristics and oil and natural gas endowment explain the primary results.

[36] I acknowledge that this analysis addresses only observable characteristics, while unobservable or difficult to quantify characteristics such as governance and bank cost structure are not directly addressed. However, given that there is no correlation in observable characteristics, and no theoretical reason that the geological features associated oil and natural gas endowment should be correlated with bank characteristics, I consider the assumption of "random" assignment to be reasonable.

5.2.3 *Ex ante* assignment

The variable *Exposure* is calculated on a bank year basis to most accurately capture the exposure of a given bank to the fracking shock in a given year. However, the time-varying nature of this variable may raise concerns that banks chose to increase the number of branches in highly impacted counties during this period; thus, there may be self-selection of banks into the exposed counties. To mitigate this concern, I replace *Exposure* with *Exposure2007*, which is the proportion of a bank's branches located in a high-endowment county in 2007, the first year of significant oil boom activity in the sample. The identification of a bank based on their branch location before the fracking shock, mitigates concerns that banks were able to self-select into greater exposure over the course of the boom activity. Table 19, column (1) presents the results of the analysis using *ex ante* exposure to the shale boom. Consistent with the primary results, the coefficient on *Post*Exposure2007* is negative and significant (β_3 = -0.025, p-value <0.10), mitigating concerns that changes in bank branch locations during the sample period could explain the findings.

Another potential concern is that banks may choose to change from a non-industry expert auditor to an industry expert auditor in response to being exposed to the fracking boom. To mitigate this concern, I reperform the analysis excluding all banks that changed auditors. Table 19, column (2) shows that the coefficient on *Post*Exposure2007* is negative and significant (β_3 = -0.040, p-value <0.10), and is even greater in magnitude compared to the estimation using the full sample. This results mitigates concerns that auditor changes in response to the fracking boom may explain the primary results.

5.2.4 Analysis of Loan Loss Provision

As discussed in Chapter 3, the loan loss provision (LLP) is often used in prior literature to assess the quality of a bank's estimate of loan losses (e.g., Altamuro and Beatty 2010; Beatty and Liao 2014). For the purposes of this study, I consider the balance sheet component, the ALL, to be the appropriate focus of the empirical analysis, nevertheless, it is important to also understand how exposure to the fracking boom affects the relationship between a bank's LLP and future charge-offs. To examine this relationship, I test hypothesis 1 using the following model adapted from (Altamuro and Beatty 2010):

$$
\begin{aligned}
ChargeOff_{ist+1} = {} & \alpha + \beta_1 Post_{ist} + \beta_2 Exposed_{ist} + \beta_3 Post{*}Exposed_{ist} + \beta_4 LLP_{ist} \\
& + \beta_5 Post{*}LLP_{ist} + \beta_6 Exposed{*}LLP_{ist} + \boldsymbol{\beta_7 Post{*}Exposed{*}LLP_{ist}} \\
& + \beta_8 Size_{ist} + \beta_8 Size{*}LLP_{ist} + \beta_9 NPA_{ist} + \beta_6 Consumer_{it} + \beta_7 C\&I_{it} \\
& + \delta_s + \lambda_t + e_{ist} \qquad (3)
\end{aligned}
$$

where subscripts refer to bank (*i*), state (s) and year (*t*). The loan loss provision (*LLP*), is defined as loan loss provision during year *t* scaled by beginning total assets, and charge-offs (*ChargeOff*), defined as charge-offs in year *t+1* scaled by beginning total assets. All other variables are defined consistent with model (1). I include time fixed effects, λ_t, to control for time effects across all observations, and I include state fixed effects, δ_s, to control for time-constant state characteristics. Consistent with Altamuro and Beatty (2010), I interact *Size*LLP* to allow for the association between LLP to vary based on bank size.[37]

[37] In an untabulated sensitivity analysis, I interact variable *Post*, *Size*, and *Post*Size* with all explanatory variables to allow for the effect of each variable to vary across bank size and across the pre- and post-boom periods. There is no change in the inference of the results from estimating the model specification with all interactions.

A positive relationship between the LLP and subsequent charge-offs is considered to be indicative of higher LLP quality. For the purposes of the analysis, I am interested in how exposure to the shale boom impacts the relationship between LLP and subsequent chargeoffs. The model uses a difference-in-differences approach where the first difference (β_6) represents the difference in LLP quality between banks in endowed and non-endowed counties prior to the onset of the boom and the difference-in-difference estimator (β_7) represents the difference in LLP provision quality between exposed and non-exposed banks after the onset of the fracking boom compared to the difference prior to the boom.[38] A negative (positive) coefficient on β_7 indicates that the quality of the LLP is lower (higher) in the post-boom period for exposed banks as compared to the quality in the pre-boom period. A lower (higher) association between current year LLP and subsequent charge-offs suggests lower (higher) LLP quality.

Table 20 presents the results of estimating model (3) to test hypothesis 1. The primary coefficient of interest is *Post*Exposed*LLP*, which measures the marginal impact of exposure to the fracking boom on bank LLP quality. Using the continuous measure of exposure in column (1), I find a negative and significant coefficient on *Post* Exposure *LLP* (β_7 = -0.160, p-value < 0.05), indicating a weaker association between the LLP accrual and subsequent charge-offs for banks located in counties with high resource endowment after the onset of the fracking boom. Similarly, I find a negative and significant coefficient on *Post*Exposed*LLP* (β_7 = -0.126, p-value < 0.10) using a dichotomous measure of exposure. The results suggest that exposure to fracking shocks results in lower LLP quality relative to banks not exposed to the shock. The finding is consistent with the primary findings presented in table 4.

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[38] The difference-in-difference estimator is determined as follows:
$\widehat{\beta_7} = (\bar{y}_{\text{Exposed,Post}} - \bar{y}_{\text{Exposed,Pre}}) - (\bar{y}_{\text{NonExposed,Post}} - \bar{y}_{\text{NonExposed,Pre}})$ where $\bar{y}$ represents the mean relationship between LLP and future charge-offs.

CHAPTER 6: CONCLUDING REMARKS

In this study, I investigate the effect of rapid growth caused by a positive economic shock on financial reporting quality. I argue that exposure to a positive economic shock presents internal and external threats to the quality of accounting estimates. Internally, rapid growth can lead to a deterioration in internal controls, which provides an opportunity for both error in estimate calculation and intentional earnings management. Externally, uncertainty in a firm's operating environment increases the challenge in developing and validating the assumptions to predict future cash flows. Consistent with an economic shock resulting in both internal and external challenges for banks, I find that ALL quality is lower for banks exposed to a positive economic shock.

I investigate the efficacy of auditor expertise in mitigating lower estimate quality following a bank's exposure to a positive economic shock. I find evidence that an auditor's task-specific expertise, developed through prior experience auditing clients exposed to a fracking shock, combined with industry-specific expertise is associated with higher estimate quality, compared to auditors with expertise resulting from general expertise, greater resources (i.e., Big 4 auditors) or industry-specific experience alone. These findings are consistent with the PCAOB's emphasis on the importance of auditors gaining a proper understanding of a client's economic environment, particularly when auditing accounting estimates. The results suggest that general and industry specific expertise, and access to extensive firm resources alone do not fully compensate for lack of first-hand knowledge of the external economic challenges facing an audit client.

I acknowledge that, as with any natural experiment, the results may not be widely generalizable. However, this study capitalizes on a strong setting to provide evidence that a firm's operating environment is an important consideration in evaluating financial reporting quality. I identify important cross-sectional variations in auditor expertise that suggest that further research is needed to understand how and when different types of auditor expertise contribute to financial reporting quality.

The primary contribution of this paper is in demonstrating that financial reporting quality and the effects of auditor expertise are not constant across a business cycle. The findings suggest that research examining financial reporting quality and auditor expertise should consider how the economic challenges facing firms could affect the results and conclusions of the research.

Additionally, this paper contributes to the banking literature by examining how positive economic shocks impact ALL quality. The results have practical implications given the importance of bank financial reporting quality to the overall economy and the importance of financial reporting during expansionary periods.

APPENDICES

APPENDIX A

ENDOWMENT MEASURE DETAILS AND VALIDATION

Endowment Measure Calculation

To measure *ex ante* oil and natural gas endowment, I use a measure constructed by Allcott and Keniston (2018). The measure is calculated as follows:

$$Endowment_c = \frac{(\sum_{t=1960}^{2013} Production_{c,2013}) + ProvenReserves_{c,2013} + UndiscoveredReserves_{c,2013}}{Area(SquareMiles)_c}$$

where subscripts represent county (c) and year (t). *Production* is the total production of natural gas and oil from 1960 to 2013. *ProvenReserves* are based on the amount of reserves that are known, but have not yet been extracted. *UndiscoveredReserves* are based on estimates by the U.S. Geological survey, which defines "undiscovered petroleum (as) that which is postulated from geologic knowledge and theory to exist outside of known accumulations (Schmoker and Klett 2013)." The endowment measure is scaled by the total square miles within a county to control for differences in county size. The resulting endowment density measure provides physical units of oil and gas, which are converted to dollar amounts based on the average price of oil and gas from 1960-2011, using real 2010 dollars.[39]

The measure that I use is calculated as of 2013; however, the total amount of endowment does not change from year to year as it is based on the total amount of oil and gas reserves that were available for extraction as of 1960. The various components of the measure (i.e., *Production*, *ProvenReserves* and *UndiscoveredReserves*) may vary from year to year, for example as oil and gas is produced it moves from being a *ProvenReserve* to being included in the production summation, but the total endowment number remains constant. The reliance of this measure on geological factors and proven reserves, rather than production alone results in the consistency, and ultimately exogeneity of the measure for use in determining which banks are exposed to fracking shocks.

[39] Average prices used are $34.92 per barrel of oil and $3.20 per mm Btu of gas (Allcott and Keniston 2018).

Endowment Measure Validation

The first step in validating the appropriateness of the Allcott and Keniston measure for the setting was to replicate the deposit growth results of Gilje et al. (2016) to demonstrate that bank deposit growth during fracking shocks is positively and significantly related to the bank county's endowment. I follow Gilje et al. (2016) in estimating the effect of high levels of endowment using the following model:

$$\Delta Deposits_{it} = \omega_1 Exposure_{it} + \omega_2 Size_{it-1} + \omega_3 Deposits_{it-1} + \omega_3 Liquidity_{it-1} + \delta_s + \lambda_t + e \quad (4)$$

where the subscripts represent bank (i), state (s) and year (t), and *ΔDeposits* represents change in deposits calculated as the natural log of the ratio of deposits in year t to deposits in year *t-1*. *Exposure* is the standardized proportion of bank *i*'s branches located in high-endowment counties in year *t*. *Size* is the natural log of total assets at the end of *t-1, Deposits* is total deposits scaled by total assets in year *t-1,* and *Liquidity* is total liquid assets (cash and cash equivalents) scaled by total assets in year *t-1*. Consistent with the primary analysis, the sample size is limited to only banks with branches located within a play state. I limit the sample period to only post-boom observations, as this is the period when exposure would be expected to impact deposit growth. The model is estimated with state fixed effects (δ_s) to control for time-invariant state characteristics and year fixed effects (λ_t) to control for time trends. The coefficient of interest is ω_1 which represents the relationship between a bank's exposure to the fracking boom and the bank's deposit growth. A positive value for ω_1 indicates that exposure to the fracking boom results in a higher deposit growth rate, which is consistent with the results in Gilje et al. (2016) and the expectations of the impact of a fracking shock on deposit growth. Table 21 presents the results of the measure validation and shows that the coefficient on *Exposure* is positive and significant, indicating that exposed banks experienced higher deposit growth than non-exposed banks following the onset of the fracking boom and providing support for the validity of the Allcott and Keniston endowment measure.

Allcott and Keniston (2018) obtained confidential access to the U.S. Energy Information Administration (EIA)'s county-level data for the proven reserves portion of the endowment measure. Due to the confidential nature of the data, I was not able to re-create the full measure, thus relied on the information provided by Hunt Allcott and Daniel Keniston. However, as a further validation of the measure, I independently construct a similar measure using information from DrillingInfo, a market research company. DrillingInfo provides an estimate of ultimate recovery of oil and natural gas (EUR) on a well-level basis.[40] This measure provides a reasonable proxy for the production and proven reserves portion of the Allcott and Keniston measure. From the well-level EUR I calculated a county-level EUR and replicated my test of H1 in this study using the EUR measure. Table 22 presents the results of this analysis and I find all results consistent with the findings using the Allcott and Keniston measure. I relied on the Allcott and Keniston measure for the primary analysis, because the measure's use of undiscovered reserves and confidential EIA data allow for stronger identification.

[40] According to DrillingInfo, the EUR for each well is the technically recoverable resources and are calculated based on a combination of historical production data and forecasts. The EUR estimates the total amount of oil and/or gas that could be recovered from a given well.

APPENDIX B

VARIABLE DEFINITIONS

Variable	Definition
ALL Level $_{it}$	natural log of one plus the allowance for loan loss for bank *i* in year *t* .
ALL Quality $_{it}$	the ratio of charge-offs in *t+1* to ALL in year t for bank *i* .
Audited $_{it}$	indicator variable equal to 1 bank *i* is audited in year *t* , 0 otherwise.
Big4 $_{it}$	indicator variable equal to 1 if bank *i* is audited in year *t* , 0 otherwise.
BankEndowment $_{it}$	the proportion of a bank's branches located in county c, multiplied by the continuous measure of *Endowment* in county c, and summed by bank. Branch location data obtained from FDIC Summary of Deposits database.
C&I $_{it}$	commercial and industrial loans scaled by total loans for bank *i* at the end of year
CO Level $_{it}$	natural log of one plus absolute net charge-offs for bank *i* in year *t* .
CO $_{it+1}$ */ALL* $_{t}$	ratio of charge-offs in *t+1* and the ALL in year *t* .
Consumer $_{it}$	consumer loans scaled by total loans for bank *i* at the end of year *t* .
C&I $_{it}$	commercial and industrial loans scaled by total loans for bank *i* at the end of year *t* .
Deposits $_{it}$	total deposits of bank *i* at the end of year *t* in millions.
Diverse_Port $_{i2007}$	indicator variable equal to 1 if the Herschman Herfindahl Index (HHI) for bank *i* is below the sample median in 2007, zero otherwise. HHI calculated as the sum of squared of proportion of loan type; $HHI_{it} = \sum_{j=1}^{k} P_j^2$, where P is the proportion of loan type j in the loan portfolio of bank i. Loan type j = Residential Real Estate (lnreres), Commercial Real Estate (lnrecons+lnremult+lnrenres), Commercial and Industrial (lnci), Agricultural Production (lnag), Farmland (lnreag), Credit Card (lncrcd), Other Consumer (lncon-lncrcd), Lease financing receivables (ls).
Endowed $_{cp}$	indicator variable equal to 1 if county *c* is above the median of *Endowment* within play *p* , 0 otherwise.

Variable	Definition
$Endowment_c$	Allcott and Keniston (2018) county-level measure of oil and gas endowment density in 2010 dollars, divided by total square miles in county. See Appendix A for further details on the calculation and validation of *Endowment*.
$Exposed_{itp}$	indicator variable equal to 1 if any of branches of bank i are located in counties that are above the median oil and gas endowment within shale play p (i.e., counties where *Endowed* = 1), 0 otherwise.
$Exposure2007_{ip}$	proportion total branches located in a county in the top quartile of endowment within a given shale play region (i.e., Endowed = 1) for bank i in year 2007. Branch location data obtained from FDIC Summary of Deposits database.
$Exposure_{it}$	proportion total branches located in a county in the top quartile of endowment within a given shale play region (i.e., *Endowed* = 1) for bank i in year t. Branch location data obtained from FDIC Summary of Deposits database.
$Exposed\_EUR_{itp}$	indicator variable equal to 1 if any of branches of bank i are located in counties that are above the median oil and gas endowment within shale play p (i.e., counties where *Endowed* = 1) based on estimate of ultimate recovery of oil and natural gas (EUR) on a well-level basis from DrillingInfo database, 0 otherwise.
$Exposure\_EUR_{it}$	proportion total branches located in a county in the top quartile of endowment within a given shale play region (i.e., *Endowed* = 1) based on estimate of ultimate recovery of oil and natural gas (EUR) on a well-level basis from DrillingInfo database for bank i in year t. Branch location data obtained from FDIC Summary of Deposits database.
$High\_Risk_{i2007}$	indicator variable equal to 1 if bank i's loan portfolio risk is greater than the sample median portfolio risk in 2007, 0 otherwise.
$HR\_Constrain_{i2007}$	indicator variable equal to 1 if a bank is above below the sample median in the ratio of full-time employees to total assets, and 0 otherwise.
$IndExpert_{it}$	indicator variable equal to 1 if bank i is audited by an industry expert auditor in year t, 0 otherwise. Industry expert is defined to be an auditor in the top 10 percent of auditors in terms of total count of banks audited in year t.
$Liquidity_{it}$	total cash and cash equivalents scaled by total assets of bank i at the end of year t.

Variable	Definition
LLP_{it}	loan loss provision scaled by beginning total assets in year *t*.
$Loans_{it}$	total loans of bank *i* at the end of year *t* in millions.
NPA_{it}	non-performing assets scaled by beginning total assets for bank *i* in year *t*.
$Post_{st}$	indicator variable equal to 1 if year *t* is after the onset of the fracking boom in state *s*. Onset of boom is considered to be the first year of significant public drilling activity in a shale play and is identified consistent with Bartik et al. (2016) as follows: Permian (2005), Marcellus (2007), Bakken (2007), Andarko (2008), Eagle Ford (2008), Haynesville (2008), Niobrara (2010), Utica (2011).
$Post\_False_{st}$	an indicator equal to 1 for the three years prior to the onset of the shale boom (i.e., *Post* = 1 in year *t-3*), 0 otherwise.
$Size_{it}$	natural log of beginning total assets for bank *i* in year *t*.
$SpecificExpert_{it}$	indicator variable equal to 1 if bank *i* is audited in year *t* by an auditor with previous experience auditing an *Exposed* bank, 0 otherwise.
$\Delta Deposits_{it}$	log change in total deposits from *t-1* to *t*.
$\Delta Rigs_{t}$	log change in number of horizontal drilling rigs from year *t-1* to year *t*. (Horizontal drill rig count obtained from the Baker Hughes North American Rotary Rig Count Report)

APPENDIX C

ILLUSTRATION OF INTERACTION OF *ENDOWED*, *EXPOSED*, AND *POST* VARIABLES

First Exchange Bank, Mannington, WV
Marion County, WV (FIPS: 54049)

State: West Virginia
Play: Marcellus
Allcott and Keniston 2013 Endowment: $2,923,458,000
County Square Miles: 311.518 mi^2
Endowment Density: $9,384,556/$mi^2$
Marcellus Play Endowment Density Top Quartile: $9,307,775/$mi^2$
First Year of Fracking Boom in State: 2007
First Year of Fracking Boom in Play: 2007

The endowment measure places Marion County in the top quartile for the play, thus Marion County is an *Endowed* county for the primary analysis. Four of First Exchange Bank's six branches (66.7 percent) are located in Marion County; thus, *Exposure* = 0.667. First Exchange Bank's has branches located in Endowed Counties; thus, *Exposed* = 1. Fracking activity began in the Marcellus Play in 2007, thus, for First Exchange Bank, *Post* = 0 for 2005-2007, and *Post* = 1 from 2008-2014.

All banks with branches in West Virginia counties, but with oil and natural gas endowment density below the top quartile for the Marcellus play (<$9,307,775/$mi^2$) are coded as *Exposed* = 0 for the full sample period, *Post* = 0 for 2005-2007, and *Post* = 1 from 2008-2014.

APPENDIX D

INCURRED LOSS MODEL VS CURRENT EXPECTED CREDIT LOSS MODEL

Prior to 2018, (i.e., the entire sample period of this paper), banks determined the necessary ALL based on the incurred loss model. Under this model, losses should be recognized only when incurred and only those losses which are inherent in the loan portfolio at the time of the financial statements should be included in the ALL. Using the incurred loss model, the ALL is developed in two parts. In one part, loans that are impaired (i.e., not expected to collect all contractual interest and principal payments) are evaluated individually to determine the inherent losses under ASC 310-10 (FAS 114). The second part of the ALL is estimated for the performing loans on a pooled basis following ASC 450 (FAS 5). The required ASC 450 allowance is determined using historical losses and qualitative adjustment factors to cover economic changes in the existing loss emergence period (i.e., the time that it will take for losses that are inherent in the portfolio to become evident). Long-horizon forecasts are explicitly prohibited in determining appropriate ALL levels using the incurred loss model. The requirement that losses be inherent in the portfolio before being recognized in the ALL is the basis for the reasonableness of the one-year period of charge-off coverage often referenced by standard setters and regulators and used as the basis for the analysis in this paper.

In June 2016, the FASB issued ASU No. 2016-13 "Measurement of Credit Losses on Financial Instruments," which replaced the existing incurred loss model. This model is uses a Current Expected Credit Loss (CECL) methodology to evaluate pooled performing loans. In addition to consideration of historical losses and current economic conditions, the methodology allows for the inclusion of reasonable and supportable forecasts in determining the appropriate ALL. Thus, rather than restricting the ALL to only the losses inherent in the portfolio as of the reporting date, CECL methodology requires banks to look forward to incorporate future expected losses into the ALL calculation. The change to the CECL model for calculating loan losses makes the understanding of the effect of an economic shock on the loan portfolio even more salient for bank management and auditors, as these groups must now not only react to the *current* effect of an economic shock, but also consider reasonable forecasts of the future effects of the shocks on the collectability of loans. The change will increase not only the number, but also the uncertainty of the assumptions underlying the development of the ALL estimate.

APPENDIX E

TABLES

Table 1

Sample Calculation

This table presents the details of the sample calculation. Panel A shows the calculation of the primary samples used to test H1 & H2. The starting point of the calculation is a merger of the bank regulatory Call Report database with the Holding company FR-Y9C database in order to obtain the auditor name. The 87,542 Regulatory Filings for 2005-2014 represent all banks with a holding company during the sample period. Panel B presents details of the calculation of the sample for the test of H2.

Panel A: Primary Sample Calculations

Regulatory Filings 2005-2014 for banks with holding company	87,542
Drop banks in top 1% of assets	(921)
Eliminate observations without majority of branches in play states	(73,540)
Eliminate observations missing necessary data	(1,104)
Eliminate banks with no lag year available	(241)
Eliminate banks with $CO_{t+1}/ALL_t > 1$	(558)
Sample Size - H1	**11,178**

Panel B: Sample Calculation for H2 Audited vs Unaudited Analysis

Sample Size - H1	11,178
Eliminate Banks with assets greater than $500 million	(1,882)
Sample Size - H2 Audited vs Unaudited Analysis	**9,296**
Sample Size - H1	11,178
Eliminate Unaudited Banks	(5,341)
Sample Size - H2 Audited Only	**5,837**

Table 2

Sample Descriptive Statistics

This table reports summary statistics for banks with at least one branch located in a state exposed to the shale boom. All observations are presented at the bank year level. Bank characteristic variables are obtained from year end bank Call Reports. Panel A presents summary statistics for the full sample. Panel B presents summary statistics separately for exposed and non-exposed banks. See APPENDIX B for variable definitions. All non-logged continuous variables are winsorized at the 1st and 99th percentile.

Panel A: Pooled Descriptive Statistics

n= 11,178

Continuous Variables	mean	sd	10th	25th	Median	75th	90th
$ALL\ Quality_{it}$	0.184	0.228	-0.008	0.020	0.111	0.284	0.518
CO_{it+1} *(millions)*	1,158	3,657	5	30	148	594	2,178
ALL_t *(millions)*	4,068	9,327	276	552	1,244	3,028	8,092
$Exposure_{it}$	0.142	0.000	0.000	0.000	0.000	0.000	0.875
$Size_{it}$	11.96	1.25	10.49	11.09	11.85	12.67	13.51
NPA_{it}	0.010	0.012	0.000	0.002	0.006	0.013	0.023
$Consumer_{it}$	0.079	0.071	0.015	0.030	0.059	0.104	0.174
$C\&I_{it}$	0.144	0.088	0.050	0.082	0.127	0.186	0.261
$Deposits_{it}$ *(millions)*	325,832	652,525	32,010	58,740	124,955	283,938	635,603
$Loans_{it}$ *(millions)*	270,394	579,898	20,765	39,813	92,885	218,193	539,274

Dichotomous Variables	mean
$Exposed_{it}$	0.220
$Audited_{it}$	0.522
$Big4_{it}$	0.059
$IndExpert_{it}$	0.108
$SpecificExpert_{it}$	0.219

Panel B: Comparison of Exposed and Non-Exposed Banks

	***Exposed* = 1** (n=2,463)			***Exposed* = 0** (n=8,715)		
Continuous Variables	mean	median	sd	mean	median	sd
$Exposure_{it}$	0.645	0.750	0.365	0.000	0.000	0.00
$Size_{it}$	12.51	12.33	1.37	11.89	11.80	1.18
NPA_{it}	0.010	0.006	0.011	0.010	0.006	0.012
$Consumer_{it}$	0.085	0.063	0.074	0.078	0.058	0.070
$C\&I_{it}$	0.149	0.137	0.086	0.142	0.124	0.088

Dichotomous Variables	mean (*Exposed* = 1)	mean (*Exposed* = 0)
$Audited_{it}$	0.671	0.480
$Big4_{it}$	0.093	0.049
$IndExpert_{it}$	0.451	0.624
$SpecificExpert_{it}$	0.368	0.177

Table 3

Correlation Matrix

This table presents the Pearson pairwise correlation matrix for key variables. Correlations in boldface type are significant at the 5% level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) *ALL Quality*$_{it}$	1										
(2) *Exposure*$_{it}$	-0.018	1									
(3) *Exposure*Post*$_{it}$	**-0.030**	0.772	1								
(4) *Size*$_{it}$	**0.182**	**0.038**	**0.065**	1							
(5) *NPA*$_{it}$	**0.316**	**-0.033**	-0.004	**0.118**	1						
(6) *Consumer*$_{it}$	**0.055**	**0.079**	**0.043**	**-0.238**	**-0.119**	1					
(7) *C&I*$_{it}$	**0.029**	0.014	0.015	-0.008	0.018	0.012	1				
(8) *Audited*$_{it}$	**0.122**	**0.100**	**0.080**	**0.529**	**0.081**	**-0.078**	**-0.07**	1			
(9) *Big4*$_{it}$	**0.082**	0.003	-0.015	**0.349**	0.013	-0.021	-0.01	**0.229**	1		
(10) *IndExpert*$_{it}$	**-0.09**	**-0.120**	**-0.093**	**-0.413**	**-0.062**	**0.057**	**0.05**	**-0.855**	**-0.27**	1	
(11) *SpecificExpert*$_{it}$	0.022	**0.128**	**0.227**	**0.302**	**0.125**	**-0.137**	**-0.07**	**0.475**	**-0.11**	**-0.301**	1

Table 4

Effect of exposure to shale boom on ALL quality

This table presents the results of the examination of the impact of exposure to a fracking shock on ALL quality. Column (1) presents the results of estimating model (1) using a continuous exposure measure (*Exposure*) equal to the proportion of a bank's branches located in a county where *Endowed* = 1. Column (2) presents the results of estimating model (1) using a dichotomous measure of exposure (*Exposed*) an indicator variable equal to one if a bank has any branches located in a county where *Endowed* = 1, zero otherwise. See APPENDIX B for detailed variable definitions. Robust standard errors are clustered by bank and are provided in parentheses below the coefficient.***,**, and * indicate two-tailed significance at the 1%, 5% and 10% levels, respectively.

	ALL Quality $_{it}$	
	(1)	(2)
Variables	Continuous	Dichotomous
Post $_{it}$	-0.011	-0.010
	(0.009)	(0.009)
Exposure $_{it}$	-0.004	-
	(0.014)	-
Post*Exposure $_{it}$	**-0.032 ** **	-
	(0.014)	-
Exposed $_{it}$	-	-0.007
	-	(0.010)
Post*Exposed $_{it}$	-	**-0.024 ** **
	-	**(0.011)**
Size $_{it}$	0.039 ***	0.040 ***
	(0.003)	(0.003)
NPA $_{it}$	3.396 ***	3.397 ***
	(0.190)	(0.190)
Consumer $_{it}$	0.314 ***	0.315 ***
	(0.051)	(0.051)
C&I $_{it}$	0.125 ***	0.127 ***
	(0.034)	(0.034)
Constant	-0.138 ***	-0.163 ***
	(0.050)	(0.049)
Year fixed effects	Yes	Yes
State fixed effects	Yes	Yes
n	11,178	11,178
R-sq	0.239	0.199

Table 5

Effect of exposure to shale boom on ALL quality - Not Limited to Over-Reserved Banks

This table presents the results of the examination of the impact of exposure to a fracking shock on ALL quality. The sample is not limited to only those bank that are over-reserved. Column (1) presents the results of estimating model (1) using a continuous exposure measure (*Exposure*) equal to the proportion of a bank's branches located in a county where *Endowed* = 1. Column (2) presents the results of estimating model (1) using a dichotomous measure of exposure (*Exposed*) an indicator variable equal to one if a bank has any branches located in a county where *Endowed* = 1, zero otherwise. See APPENDIX B for detailed variable definitions. Robust standard errors are clustered by bank and are provided in parentheses below the coefficient.***,**, and * indicate two-tailed significance at the 1%, 5% and 10% levels, respectively.

	ALL Quality $_{it}$	
	(1)	(2)
Variables	Continuous	Dichotomous
Post $_{it}$	-0.026 *	-0.027 *
	(0.016)	(0.016)
Exposure $_{it}$	-0.006	-
	(0.023)	-
Post*Exposure $_{it}$	**-0.044 ***	-
	(0.023)	-
Exposed $_{it}$	-	0.001
	-	(0.021)
Post*Exposed $_{it}$	-	**-0.040 ***
	-	**(0.022)**
Size $_{it}$	0.048 ***	0.048 ***
	(0.005)	(0.005)
NPA $_{it}$	5.490 ***	5.491 ***
	(0.300)	(0.300)
Consumer $_{it}$	0.517 ***	0.514 ***
	(0.127)	(0.127)
C&I $_{it}$	0.287 ***	0.285 ***
	(0.065)	(0.065)
Constant	-0.451 ***	-0.451 ***
	(0.072)	(0.072)
Year fixed effects	Yes	Yes
State fixed effects	Yes	Yes
n	11,743	11,743
R-sq	0.205	0.205

Table 6

Effect of exposure to shale boom on charge-offs and ALL

This table presents the results of an examination of the effect of exposure to a shale boom on the level of charge-offs and level of ALL separately. Column (1) presents the results of estimating model (1) using the natural log of one plus charge-offs (*CO Level)* as the dependent variable. Column (2) presents the results of estimating model (1) using the natural log of one plus the ALL (*ALL Level*) as the dependent variable. See APPENDIX B for detailed variable definitions. Robust standard errors are clustered by bank and are provided in parentheses below the coefficient.***,**, and * indicate two-tailed significance at the 1%, 5% and 10% levels, respectively.

	(1)	(2)
Variables	*CO Level*	*ALL Level*
$Post_{it}$	-0.074	-0.005
	(0.054)	(0.015)
$Exposure_{it}$	-0.063	-0.045
	(0.094)	(0.040)
$Post*Exposure_{it}$	**-0.306 *** **	**-0.029**
	(0.100)	**(0.037)**
$Size_{it}$	1.265 ***	1.030 ***
	(0.021)	(0.009)
NPA_{it}	32.615 ***	7.953 ***
	(1.345)	(0.464)
$Consumer_{it}$	2.374 ***	-1.071 ***
	(0.416)	(0.279)
$C\&I_{it}$	1.415 ***	0.483 ***
	(0.283)	(0.124)
Constant	-9.820	-4.958 ***
	(0.667)	(0.231)
Year fixed effects	Yes	Yes
State fixed effects	Yes	Yes
n	11,178	11,178
R-sq	0.603	0.8956

Table 7

Effect of human resource constraints on ALL quality during shale booms

This table presents the results of a supplemental test of H1. Panel A presents the results of estimating model (1) separately for two different subsamples based on HR constraint composition. Each column contains a different subsample as follows: banks with below median 2007 HR constraint in column (1) and banks with below median 2007 HR constraint in column (2). Panel B presents chi-sq tests of differences in coefficients across the different subsample regressions in Panel A. The top line indicates the auditor type being examined, while the second line indicates which regression columns in Panel A are being compared. The bottom row provides the p-value for the chi-sq test of difference in coefficient significance. All variables are defined in APPENDIX B, and all continuous variables are winsorized at the 1st and 99th percentile. Robust standard errors are clustered by bank and are provided in parentheses below the coefficient.***,**, and * indicate two-tailed significance at the 1%, 5% and 10% levels, respectively.

Panel A: High vs Low Human Resource Constraint		
	ALL Quality	
	(1)	(2)
Variables	*HR_Constrain = 0*	*HR_Constrain = 1*
Post $_{it}$	-0.014	-0.008
	(0.010)	(0.010)
Exposure $_{it}$	-0.004	-0.007
	(0.014)	(0.020)
Post*Exposure $_{it}$	**-0.035 ****	**-0.015**
	(0.016)	**(0.021)**
Size $_{it}$	0.039 ***	0.029 ***
	(0.003)	(0.003)
NPA $_{it}$	2.427 ***	2.726 ***
	(0.187)	(0.227)
Consumer $_{it}$	0.273 ***	0.211 ***
	(0.053)	(0.065)
C&I $_{it}$	0.062	0.138 ***
	(0.041)	(0.038)
Constant	-0.403 ***	-0.289 ***
	(0.043)	(0.037)
Year fixed effects	Yes	Yes
State fixed effects	Yes	Yes
n	5,580	5,591
R-sq	0.192	0.232

Table 7 (cont'd)

Effect of human resource constraints on ALL quality during shale booms

Panel B: Tests of difference in coefficients across subsamples	
Comparison	High vs Low HR
Columns from Panel A:	(2) - (1)
*Post*Exposure* coeff diff	0.020
p-value	0.447

Table 8

Effect of portfolio composition on ALL quality during shale booms

This table presents the results of a supplemental test of H1. Panel A presents the results of estimating model (1) separately for four different subsamples based on portfolio composition. Each column contains a different subsample as follows: banks with below median 2007 portfolio risk in column (1), banks with above median 2007 portfolio risk column (2), banks with below median 2007 portfolio heterogeneity in column (3), banks with above median 2007 portfolio heterogeneity in column (4). Panel B presents chi-sq tests of differences in coefficients across the different subsample regressions in Panel A. The top line indicates the auditor type being examined, while the second line indicates which regression columns in Panel A are being compared. The bottom row provides the p-value for the chi-sq test of difference in coefficient significance. All variables are defined in APPENDIX B, and all continuous variables are winsorized at the 1st and 99th percentile. Robust standard errors are clustered by bank and are provided in parentheses below the coefficient.***,**, and * indicate two-tailed significance at the 1%, 5% and 10% levels, respectively.

Panel A: Expert vs Non-Expert Auditor Banks

	ALL Quality			
	(1)	(2)	(3)	(4)
Variables	*High_Risk=0*	*High_Risk=1*	*Diverse_Port=0*	*Diverse_Port=1*
$Post_{it}$	-0.007	-0.016	-0.007	-0.002
	(0.010)	(0.011)	(0.014)	(0.019)
$Exposure_{it}$	-0.014	0.006	-0.011	-0.010
	(0.015)	(0.016)	(0.010)	(0.011)
$Post*Exposure_{it}$	**-0.028 ***	**-0.023**	**-0.035 ****	**-0.018**
	(0.016)	**(0.016)**	**(0.015)**	**(0.019)**
$Size_{it}$	0.029 ***	0.030 ***	0.034 ***	0.031 ***
	(0.003)	(0.003)	(0.003)	(0.003)
NPA_{it}	2.746 ***	2.463 ***	2.509 ***	2.599 ***
	(0.236)	(0.194)	(0.164)	(0.275)
$Consumer_{it}$	0.141	0.190 ***	0.180 ***	0.344 ***
	(0.105)	(0.048)	(0.066)	(0.057)
$C\&I_{it}$	0.134 **	0.009	0.096 **	0.080 *
	(0.053)	(0.036)	(0.038)	(0.043)
Constant	-0.268 ***	-0.291 ***	-0.352 ***	-0.288 ***
	(0.042)	(0.040)	(0.040)	(0.041)
Year fixed effects	Yes	Yes	Yes	Yes
State fixed effects	Yes	Yes	Yes	Yes
n	5,464	5,714	5,711	5,467
R-sq	0.193	0.209	0.266	0.174

Table 8 (cont'd)

Effect of portfolio composition on ALL quality during shale booms

Panel B: Tests of difference in coefficients across subsamples

	(1)	(2)
Comparison	*High_Risk*	*Diverse_Port*
Columns from Panel A:	(2) - (1)	(4) - (3)
*Post*Exposure* coeff diff	0.005	0.017
p-value	0.807	0.491

Table 9

Effect of general auditor expertise on ALL quality during shale booms

This table presents the results of a test of H2. Panel A presents the results of estimating model (2) separately for four different subsamples based on auditor type. Each column contains a different subsample as follows: unaudited banks with assets less than $500 million in column (1), audited banks with assets less than $500 million in column (2), audited banks with a non-Big4 auditor in column (3), banks audited by a Big 4 auditor in column (4). Panel B presents chi-sq tests of differences in coefficients across the different subsample regressions in Panel A. The top line indicates the auditor type being examined, while the second line indicates which regression columns in Panel A are being compared. The bottom row provides the p-value for the chi-sq test of difference in coefficient significance. All variables are defined in APPENDIX B, and all continuous variables are winsorized at the 1st and 99th percentile. Robust standard errors are clustered by bank and are provided in parentheses below the coefficient.***,**, and * indicate two-tailed significance at the 1%, 5% and 10% levels, respectively.

Panel A: Expert vs Non-Expert Auditor Banks

	ALL Quality			
	(1)	(2)	(3)	(4)
Variables	*Audit*=0	*Audit*=1	*Big4*=0	*Big4*=1
$Post_{it}$	0.007	-0.056 ***	-0.036 ***	0.046
	(0.017)	(0.016)	(0.013)	(0.041)
$Exposure_{it}$	-0.049 *	0.020	0.017	0.069
	(0.028)	(0.018)	(0.019)	(0.055)
$Post*Exposure_{it}$	**-0.007**	**-0.039 ***	**-0.033**	**-0.054**
	(0.025)	**(0.022)**	**(0.020)**	**(0.078)**
$Size_{it}$	0.050 ***	0.038 ***	0.036 ***	0.027 **
	(0.009)	(0.007)	(0.004)	(0.012)
NPA_{it}	3.400 ***	3.681 ***	3.882 ***	3.817 ***
	(0.307)	(0.274)	(0.247)	(0.886)
$Consumer_{it}$	0.535 ***	0.254 ***	0.190 ***	0.574 ***
	(0.150)	(0.088)	(0.070)	(0.217)
$C\&I_{it}$	0.298 ***	0.084	0.054	0.196
	(0.074)	(0.056)	(0.050)	(0.167)
Constant	-0.520 ***	-0.142	0.054 ***	-0.244
	(0.116)	(0.088)	(0.058)	(0.153)
Year fixed effects	Yes	Yes	Yes	Yes
State fixed effects	Yes	Yes	Yes	Yes
n	5,240	4,056	5,182	655
R-sq	0.263	0.222	0.262	0.386

Table 9 (cont'd)

Effect of general auditor expertise on ALL quality during shale booms

Panel B: Tests of difference in coefficients across subsamples

	(1)	(2)
Comparison	*Audited*	*Big4*
Columns from Panel A:	(2) - (1)	(4) - (3)
*Post*Exposure* coeff diff	-0.033	-0.021
p-value	0.684	0.785

Table 10

Effect of auditor industry expertise on ALL quality during shale booms

This table presents the results of a test of H2. Panel A presents the results of estimating model (2) separately for four different subsamples based auditor industry expertise. Each column contains a different subsample as follows: banks audited by a non-industry expert auditor in column (1), banks audited by an industry expert auditor in column (2), banks audited by an auditor without specific expertise in column (3), and banks audited by an auditor with specific expertise in column (4). Panel B, presents chi-sq tests of differences in coefficients across the different subsample regressions in Panel A. The top line indicates the auditor type being examined, while the second line indicates which regression columns in Panel A are being compared. All variables are defined in APPENDIX B, and all continuous variables are winsorized at the 1st and 99th percentile. Robust standard errors are clustered by bank and are provided in parentheses below the coefficient.***,**, and * indicate two-tailed significance at the 1%, 5% and 10% levels, respectively.

Panel A: Expert vs Non-Expert Auditor Banks

	ALL Quality			
	(1)	(2)	(3)	(4)
Variables	*IndExpert=0*	*IndExpert=1*	*SpecificExpert=0*	*SpecificExpert=1*
$Post_{it}$	-0.034 **	0.009	-0.020	-0.015
	(0.015)	(0.023)	(0.015)	(0.022)
$Exposure_{it}$	0.030 *	-0.077	0.024	0.014
	(0.018)	(0.050)	(0.018)	(0.059)
$Post*Exposure_{it}$	**-0.047 ****	**0.069**	**-0.060 ****	**-0.038**
	(0.021)	**(0.046)**	**(0.026)**	**(0.059)**
$Size_{it}$	0.043 ***	0.030 ***	0.049 ***	0.029 ***
	(0.005)	(0.006)	(0.005)	(0.005)
NPA_{it}	3.804 ***	3.901 ***	4.363 ***	3.511 ***
	(0.275)	(0.495)	(0.346)	(0.238)
$Consumer_{it}$	0.320 ***	0.203 **	0.373 ***	0.161 *
	(0.084)	(0.091)	(0.087)	(0.086)
$C\&I_{it}$	0.029	0.252 **	0.084	0.093
	(0.050)	(0.101)	(0.055)	(0.063)
Constant	-0.243 ***	-0.287 ***	-0.294 ***	-0.027
	(0.067)	(0.089)	(0.080)	(0.102)
Year fixed effects	Yes	Yes	Yes	Yes
State fixed effects	Yes	Yes	Yes	Yes
n	4,629	1,208	3,387	2,450
R-sq	0.260	0.190	0.283	0.294

Table 10 (cont'd)

Effect of auditor industry expertise on ALL quality during shale booms

Panel B: Tests of difference in coefficients across subsamples		
	(1)	(2)
Comparison	Industry Expertise	Specific Expertise
Columns from Panel A:	(2) - (1)	(4) - (3)
*Post*Exposure* coeff diff	0.116**	0.022*
p-value	0.019	0.061

Table 11

Effect of expert auditors compared to unaudited

This table presents the results of a test of H2. Panel A presents the results of estimating model (2) separately for three different subsamples based on auditor type. Each column contains a different subsample as follows: unaudited banks with assets less than $500 million in column (1), banks with assets less than $500 million audited by a Big 4 auditor in column (2), banks with assets less than $500 million audited by an industry expert auditor in column (3). Panel B presents chi-sq tests of differences in coefficients across the different subsample regressions in Panel A. The top line indicates the auditor type being examined, while the second line indicates which regression columns in Panel A are being compared. The bottom row provides the p-value for the chi-sq test of difference in coefficient significance. All variables are defined in APPENDIX B, and all continuous variables are winsorized at the 1st and 99th percentile. Robust standard errors are clustered by bank and are provided in parentheses below the coefficient.***,**, and * indicate two-tailed significance at the 1%, 5% and 10% levels, respectively.

Panel A: Unaudited vs Expert-Audited Banks

	ALL Quality		
	(1)	(2)	(3)
Variables	*Audit*=0	*Big4* =1	*IndExpert=1*
$Post_{it}$	0.004	0.123	-0.005
	(0.013)	(0.093)	(0.034)
$Exposure_{it}$	-0.036 *	0.047	-0.087
	(0.021)	(0.049)	(0.057)
Post*Exposure $_{it}$	**-0.019**	**-0.108**	**0.101 ***
	(0.020)	**(0.153)**	**(0.058)**
$Size_{it}$	0.049 ***	0.033	0.037 **
	(0.005)	(0.039)	(0.018)
NPA_{it}	2.879 ***	5.327 ***	4.175 ***
	(0.268)	(0.789)	(0.663)
$Consumer_{it}$	0.386 ***	0.877 **	0.125
	(0.077)	(0.341)	(0.161)
$C\&I_{it}$	0.191 ***	0.290	0.149
	(0.049)	(0.286)	(0.148)
Constant	-0.485 ***	-0.347	-0.428 *
	(0.059)	(0.485)	(0.222)
Year fixed effects	Yes	Yes	Yes
State fixed effects	Yes	Yes	Yes
n	5,240	247	624
R-sq	0.193	0.417	0.300

Table 11 (cont'd)

Effect of expert auditors compared to unaudited

Panel B: Tests of difference in coefficients across subsamples

	(1)	(2)
Comparison	*Big 4*	*IndustryExp*
Columns from Panel A:	(2) - (1)	(3)-(1)
*Post*Exposure* coeff diff	-0.089 **	-0.082 **
p-value	0.045	0.046

Table 12

Effect of auditor industry expertise on ALL quality during shale booms

This table presents the results of a comparison of a single expertise (i.e., either industry or specific expertise) to banks audited by non-experts or auditors with combination of both industry and specific expertise. Panel A presents the results of estimating model (2) separately for three different subsamples based auditor industry expertise. Each column contains a different subsample as follows: banks audited by an auditor with *neither* industry nor specific expertise in column (1), banks audited by an auditor with *either* industry or specific expertise in column (2), and banks audited by auditors with *both* industry and specific expertise in column (3). Panel B, presents chi-sq tests of differences in coefficients across the different subsample regressions in Panel A. The top line indicates the auditor type being examined, while the second line indicates which regression columns in Panel A are being compared. All variables are defined in APPENDIX B, and all continuous variables are winsorized at the 1st and 99th percentile. Robust standard errors are clustered by bank and are provided in parentheses below the coefficient.***,**, and * indicate two-tailed significance at the 1%, 5% and 10% levels, respectively.

Panel A: Expert vs Non-Expert Auditor Banks

	ALL Quality		
	(1)	(2)	(3)
	Neither Industry	**Either** Industry **or**	**Both** Industry **and**
Variables	**nor** Specific Expert	Specific Expert	Specific Expert
$Post_{it}$	-0.029 *	0.010	-0.008
	(0.017)	(0.023)	(0.209)
$Exposure_{it}$	0.030	0.040	-0.103
	(0.019)	(0.056)	(0.074)
Post*Exposure $_{it}$	**-0.053 ****	**-0.070**	**0.106**
	(0.027)	**(0.056)**	**(0.064)**
$Size_{it}$	0.052 ***	0.031 ***	0.027 ***
	(0.005)	(0.056)	(0.008)
NPA_{it}	4.116 ***	3.862 ***	3.436 ***
	(0.355)	(0.404)	(0.484)
$Consumer_{it}$	0.392 ***	0.256 ***	0.064
	(0.100)	(0.404)	(0.119)
$C\&I_{it}$	0.039	0.125 *	0.141
	(0.057)	(0.071)	(0.104)
Constant	-0.301 ***	-0.123	0.016
	(0.080)	(0.203)	(0.130)
Year fixed effects	Yes	Yes	Yes
State fixed effects	Yes	Yes	Yes
n	2,941	2,134	762
R-sq	0.274	0.317	0.352

Table 12 (cont'd)

Effect of auditor industry expertise on ALL quality during shale booms

Panel B: Tests of difference in coefficients across subsamples		
	(1)	(2)
Comparison	Single Expertise vs NonExpert	Combination vs Single Expertise
Columns from Panel A:	(2) - (1)	(3) - (2)
*Post*Exposure* coeff diff	-0.017*	0.176*
p-value	0.081	0.053

Table 13

Effect of single expertise compared to non-experts

This table presents the results of a test of H2. Panel A presents the results of estimating model (2) separately for three different subsamples based on auditor type. Each column contains a different subsample as follows: banks audited by an auditor with neither industry nor specific expertise in column (1), banks audited by an auditor with only inudustry expertise in column (2), banks audited by an auditor with only task-specific expertise in column (3). Panel B presents chi-sq tests of differences in coefficients across the different subsample regressions in Panel A. The top line indicates the auditor type being examined, while the second line indicates which regression columns in Panel A are being compared. The bottom row provides the p-value for the chi-sq test of difference in coefficient significance. All variables are defined in APPENDIX B, and all continuous variables are winsorized at the 1st and 99th percentile. Robust standard errors are clustered by bank and are provided in parentheses below the coefficient.***,**, and * indicate two-tailed significance at the 1%, 5% and 10% levels, respectively.

Panel A: Unaudited vs Expert-Audited Banks

	ALL Quality		
	(1)	(2)	(3)
Variables	**Neither** Industry **nor** Specific Expert	Only Industry Expertse	Only Specific Expertise
$Post_{it}$	-0.029 *	0.034	0.022
	(0.017)	(0.035)	(0.035)
$Exposure_{it}$	0.030	-0.094 **	0.173 **
	(0.019)	(0.044)	(0.079)
Post*Exposure $_{it}$	**-0.053 ****	**0.032**	**-0.202 ****
	(0.027)	**(0.102)**	**(0.079)**
$Size_{it}$	0.052 ***	0.034 ***	0.029 ***
	(0.005)	(0.009)	(0.007)
NPA_{it}	4.116 ***	6.979 ***	3.666 ***
	(0.355)	(0.929)	(0.418)
$Consumer_{it}$	0.392 ***	0.526 ***	0.215 *
	(0.100)	(0.127)	(0.114)
$C\&I_{it}$	0.039	0.468 **	0.074
	(0.057)	(0.170)	(0.076)
Constant	-0.301 ***	-0.069	-0.137
	(0.080)	(0.141)	(0.118)
Year fixed effects	Yes	Yes	Yes
State fixed effects	Yes	Yes	Yes
n	2,941	446	1,688
R-sq	0.274	0.454	0.292

Table 13 (cont'd)

Effect of single expertise compared to non-experts

Panel B: Tests of difference in coefficients across subsamples

	(1)	(2)
Comparison	*Industry Only*	*Specific Only*
Columns from Panel A:	(2) - (1)	(3)-(1)
*Post*Exposure* coeff diff	0.085	-0.149 ***
p-value	0.127	0.010

Table 14

Effect of Big 4 expertise compared to industry expertise

This table presents the results a comparison of banks audited by Big 4 auditors to banks audited by non-Big 4 auditors with a combination of industyr and task-specific expertise. Panel A presents the results of estimating model (2) separately for two different subsamples based auditor expertise as follows: banks audited by a Big 4 auditor in column (1), and banks audited by a non-Big 4 auditor with *both* industry and specific expertise in column (2). Panel B, presents chi-sq tests of differences in coefficients across the different subsample regressions in Panel A. The top line indicates the auditor type being examined, while the second line indicates which regression columns in Panel A are being compared. All variables are defined in APPENDIX B, and all continuous variables are winsorized at the 1st and 99th percentile. Robust standard errors are clustered by bank and are provided in parentheses below the coefficient.***,**, and * indicate two-tailed significance at the 1%, 5% and 10% levels, respectively.

Panel A: Big 4 vs Non-Big 4 Combination Expert Auditor Banks

	ALL Quality	
	(1)	(2) **Both** Industry **and** Specific Expert &
Variables	*Big 4 = 1*	*Big 4* = 0
$Post_{it}$	0.046	-0.007
	(0.041)	(0.023)
$Exposure_{it}$	0.069	-0.077
	(0.055)	(0.059)
Post*Exposure $_{it}$	**-0.054**	**0.110 ****
	(0.078)	**(0.043)**
$Size_{it}$	0.027 **	0.018 **
	(0.012)	(0.007)
NPA_{it}	3.817 ***	3.090 ***
	(0.886)	(0.550)
$Consumer_{it}$	0.574 ***	0.101
	(0.217)	(0.121)
$C\&I_{it}$	0.196	0.059
	(0.167)	(0.092)
Constant	-0.244	0.002
	(0.153)	(0.080)
Year fixed effects	Yes	Yes
State fixed effects	Yes	Yes
n	655	610
R-sq	0.386	0.347

Table 14 (cont'd)

Effect of Big 4 expertise compared to industry expertise

Panel B: Tests of difference in coefficients across subsamples

	(1)
Comparison	Combination vs Big 4
Columns from Panel A:	(2) - (1)
*Post*Exposure* coeff diff	0.164*
p-value	0.063

Table 15

Effect of changes in horizontal drilling on ALL quality

This table presents the results of estimating equation (2), which examines the impact of a change in horizontal drilling rigs and oil and natural gas endowment on ALL quality. The dependent variable is the percentage change in the CO/ALL ratio from *t-1* to *t*. Δ*Rigs* is percentage change in horizontal drilling rig count from *t-1* to *t* *BankEndowment* is the proportion of bank branches located within county *c* multiplied by the oil and gas endowment of county *c* ($Endowment_c$) and summed for bank $_i$. The main effect of *ΔRigs* is subsumed by year fixed effects. See APPENDIX B for detailed variable definitions. Robust standard errors are clustered by bank and are provided in parentheses below the coefficient.***,**, and * indicate two-tailed significance at the 1%, 5% and 10% levels, respectively.

Variables	*ΔALL Quality*
$BankEndowment_{it}$	0.012
	(0.009)
$BankEndowment*\Delta Rigs_{it}$	**-0.067 ****
	(0.029)
$\Delta Size_{it}$	-0.068
	(0.084)
ΔNPA_{it}	4.166 ***
	(0.648)
$\Delta Consumer_{it}$	0.006 ***
	(0.027)
$\Delta C\&I_{it}$	0.008
	(0.063)
Constant	0.138 ***
	(0.029)
Year fixed effects	Yes
State fixed effects	Yes
n	32,535
R-sq	0.089

Table 16

Falsification Test

This table presents the results of a falsification test of H1. The variable *Post_False* is an indicator variable equalty to 1 for years t-3 and subsequent relative to the onset of the fracking boom. Column (1) presents the results of estimating model (1) using only those observations prior to the onset of the fracking boom (*Post* = 0). Column (2) presents the results of estimating model (1) all observations. See APPENDIX B for detailed variable definitions. Robust standard errors are clustered by bank and are provided in parentheses below the coefficient.***,**, and * indicate two-tailed significance at the 1%, 5% and 10% levels, respectively.

	ALL Quality $_{it}$	
	(1)	(2)
Variables	Exclude Post	All Observations
Post_False $_{it}$	0.007	0.004
	(0.014)	(0.007)
Exposure $_{it}$	0.002	-0.030 ***
	(0.023)	(0.010)
Post_False*Exposure $_{it}$	**-0.011**	0.022
	(0.026)	(0.015)
Size $_{it}$	0.043 ***	0.039 ***
	(0.004)	(0.003)
NPA $_{it}$	4.118 ***	3.401 ***
	(0.323)	(0.190)
Consumer $_{it}$	0.426 ***	0.312 ***
	(0.072)	(0.051)
C&I $_{it}$	0.082 *	0.124 ***
	(0.048)	(0.034)
Constant	-0.540 ***	-0.419 ***
	(0.054)	(0.039)
Year fixed effects	Yes	Yes
State fixed effects	Yes	Yes
n	4,413	11,178
R-sq	0.235	0.239

Table 17

Correlation of exposure measure with *ex ante* observable bank characteristics

Each row of this table presents the results of a univariate regression of an observable bank characteristic on an *ex ante* measure of a bank's exposure to the shale boom. Each regression is estimated with year and state fixed effects and standard errors are clustered by bank. The sample is limited to banks in the pre-shale boom period *(Post* = 0). *Exposure2007* is the proportion of branches located in highly endowed counties in 2007 (the first year of significant shale boom activity for sample banks). *ChargeOff, ALL, Size, NPA,* and *ΔDeposits* are defined consistent with my main analyses and are defined in APPENDIX B. None of the bank characteristics are significantly associated with *Exposure2007* based on a two-tailed test at the 10% significance level.

	$Exposure2007_i$				
Variables	coeff	p-value	n	state FE	year FE
$ALL\ Quality_{it}$	-0.088	0.463	4,623	Yes	Yes
$CO\ Level_{it}$	-8.538	0.190	4,623	Yes	Yes
$ALL\ Level_{it}$	-8.875	0.276	4,623	Yes	Yes
$Size_{it}$	-0.048	0.187	4,623	Yes	Yes
NPA_{it}	-1.963	0.530	4,623	Yes	Yes
$\Delta Deposits_{it}$	-0.003	0.991	4,623	Yes	Yes

Table 18

Effect of exposure to shale boom on ALL quality - Banks Under 500 million

This table presents the results of the examination of the impact of exposure to a fracking shock on ALL quality for a sample limited to banks with under 500 million in assets. Column (1) presents the results of estimating model (1) using a continuous exposure measure (*Exposure*) equal to the proportion of a bank's branches located in a county where *Endowed* = 1. Column (2) presents the results of estimating model (1) using a dichotomous measure of exposure (*Exposed*) an indicator variable equal to one if a bank has any branches located in a county where *Endowed* = 1, zero otherwise. See APPENDIX B for detailed variable definitions. Robust standard errors are clustered by bank and are provided in parentheses below the coefficient.***,**, and * indicate two-tailed significance at the 1%, 5% and 10% levels, respectively.

	ALL Quality $_{it}$	
	(1)	(2)
Variables	Continuous	Dichotomous
Post $_{it}$	-0.020 **	-0.020 **
	(0.010)	(0.010)
Exposure $_{it}$	-0.007	-
	(0.014)	-
Post*Exposure $_{it}$	**-0.027 ***	-
	(0.015)	-
Exposed $_{it}$	-	-0.005
	-	(0.013)
Post*Exposed $_{it}$	-	**-0.027 ****
	-	**(0.013)**
Size $_{it}$	0.046 ***	0.046 ***
	(0.004)	(0.004)
NPA $_{it}$	3.368 ***	3.365 ***
	(0.202)	(0.202)
Consumer $_{it}$	0.350 ***	0.350 ***
	(0.058)	(0.058)
C&I $_{it}$	0.119 ***	0.119 ***
	(0.037)	(0.037)
Constant	-0.469 ***	-0.467 ***
	(0.049)	(0.049)
Year fixed effects	Yes	Yes
State fixed effects	Yes	Yes
n	9,296	9,296
R-sq	0.204	0.205

Table 19

Effect of *ex ante* exposure to shale boom on ALL quality

This table presents the results of the examination of the impact of exposure to a fracking shock on ALL quality, using exposure based on bank branch locations in 2007. Column (1) presents the results of estimating model (1) using a continuous exposure measure (*Exposure*) equal to the proportion of a bank's branches located in a county where *Endowed* = 1. Column (2) presents the results of the effect of ex ante exposure to the shale boom excluding auditor changes during the sample period. See APPENDIX B for detailed variable definitions. Robust standard errors are clustered by bank and are provided in parentheses below the coefficient.***,**, and * indicate two-tailed significance at the 1%, 5% and 10% levels, respectively.

	ALL Quality $_{it}$	
	(1)	(2)
Variables	All Observations	Exclude Auditor Change
Post $_{it}$	-0.011	-0.002
	(0.009)	(0.020)
Exposure $_{it}$	-0.008	**0.011**
	(0.014)	**(0.011)**
Post*Exposure2007 $_{i}$	**-0.025 ***	**-0.04** **
	(0.014)	**(0.018)**
Size $_{it}$	0.040 ***	0.040 ***
	(0.003)	(0.004)
NPA $_{it}$	3.398 ***	3.162 ***
	(0.194)	(0.223)
Consumer $_{it}$	0.322 ***	0.316 ***
	(0.052)	(0.066)
C&I $_{it}$	0.121 ***	0.197 ***
	(0.035)	(0.045)
Constant	-0.429 ***	-0.414 ***
	(0.039)	(0.050)
Year fixed effects	Yes	Yes
State fixed effects	Yes	Yes
n	10,900	7,062
R-sq	0.242	0.242

Table 20

Effect of exposure to shale boom on provision quality

This table presents the results of estimating model (3) to examine the impact of exposure to a fracking shock on provision quality. Column (1) presents the results of estimating model (3) using a continuous exposure measure (*Exposure*) equal to the proportion of a bank's branches located in a county where *Endowed* = 1. Column (2) presents the results of estimating model (1) using a dichotomous measure of exposure (*Exposed*) an indicator variable equal to one if a bank has any branches located in a county where *Endowed* = 1, zero otherwise. See APPENDIX B for detailed variable definitions. Robust standard errors are clustered by bank and are provided in parentheses below the coefficient.***,**, and * indicate two-tailed significance at the 1%, 5% and 10% levels, respectively.

	$ChargeOffs_{it+1}$	
Variables	Continuous	Dichotomous
$Post_{it}$	0.000	0.000
	(0.000)	(0.000)
$Exposure_{it}$	0.000 **	-0.000
	(0.000)	(0.000)
$Post*Exposure_{it}$	0.000	0.000
	(0.000)	(0.000)
LLP_{it}	0.382 ***	0.386 ***
	(0.026)	(0.026)
$Post*LLP_{it}$	-0.052 *	-0.057 **
	(0.029)	(0.029)
$Exposure*LLP_{it}$	0.089 *	0.059
	(0.051)	**(0.044)**
Post*Exposure*LLP $_{it}$	**-0.160 ****	**-0.126** *
	(0.076)	**(0.069)**
$Size_{it}$	0.000 **	0.0000 **
	(0.000)	(0.000)
$Size*LLP_{it}$	0.066 ***	0.066 ***
	(0.010)	(0.010)
NPA_{it}	0.090 ***	0.090 ***
	(0.007)	(0.007)
$Consumer_{it}$	0.003 ***	0.003 ***
	(0.001)	(0.001)
$C\&I_{it}$	0.001 ***	0.001 ***
	(0.000)	(0.000)
Constant	-0.001 **	-0.001 **
	(0.001)	(0.001)
Year fixed effects	Yes	Yes
State fixed effects	Yes	Yes
n	11,743	11,743
R-sq	0.454	0.454

Table 21

Effect of Exposure to Shale Boom on Deposit Growth

This table reports the results of a regression of change in deposits on measures of bank exposure to the shale-boom. The sample period is limited to observations where *Post* = 1. See APPENDIX B for variable definitions. Continuous variables are winsorized at the 1st and 99th percentile. Robust standard errors are clustered by bank. All regressions include year and state fixed effects. ***,**, and * indicate two-tailed significance at the 1%, 5% and 10% levels, respectively.

Variables	$\Delta Deposits_{it}$
Exposure $_{it}$	**0.016 *****
	(0.001)
Size $_{it}$	0.001
	(0.002)
Deposits $_{it}$	-0.223 ***
	(0.040)
Liquidity $_{it}$	-0.030
	(0.032)
Constant	0.227 ***
	(0.049)
Year fixed effects	Yes
State fixed effects	Yes
n	6,989
R-sq	0.044

Table 22

Effect of exposure to shale boom on ALL quality - Alternative endowment measure

This table presents the results of the examination of the impact of exposure to a fracking shock on ALL quality using an alternative endowment measure from DrillingInfo. Column (1) presents the results of estimating model (1) using a continuous exposure measure (*Exposure*) equal to the proportion of a bank's branches located in a county where *Endowed* = 1. Column (2) presents the results of estimating model (1) using a dichotomous measure of exposure (*Exposed*) an indicator variable equal to one if a bank has any branches located in a county where *Endowed* = 1, zero otherwise. See APPENDIX B for detailed variable definitions. Robust standard errors are clustered by bank and are provided in parentheses below the coefficient.***,**, and * indicate two-tailed significance at the 1%, 5% and 10% levels, respectively.

	ALL Quality $_{it}$	
	(1)	(2)
Variables	Continuous	Dichotomous
Post $_{it}$	-0.012	-0.012
	(0.009)	(0.009)
Exposure_EUR $_{it}$	0.007	-
	(0.017)	-
Post*Exposure_EUR $_{it}$	**-0.032 ***	-
	(0.018)	-
Exposed_EUR $_{it}$	-	0.012
	-	(0.015)
Post*Exposed_EUR $_{it}$	-	**-0.032 ** **
	-	**(0.016)**
Size $_{it}$	0.039 ***	0.039 ***
	(0.003)	(0.003)
NPA $_{it}$	3.412 ***	3.411 ***
	(0.190)	(0.199)
Consumer $_{it}$	0.308 ***	0.307 ***
	(0.051)	(0.051)
C&I $_{it}$	0.123 ***	0.123 ***
	(0.034)	(0.034)
Constant	-0.312 ***	-0.310 ***
	(0.039)	(0.039)
Year fixed effects	Yes	Yes
State fixed effects	Yes	Yes
n	11,178	11,178
R-sq	0.239	0.238

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