

**Essays on Banking**

by

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Essays on Banking

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The first chapter examines the impact of bank regulatory enforcement actions on the competitive structure of banking markets. As regulatory actions are intended to correct safety and soundness concerns within a troubled bank and can significantly limit a bank's behavior, I examine the response of rival banks to this operational constraint. Specifically, I explore whether there is a shift in local competition and the subsequent implications of the change in competition for bank stability and profitability. My findings demonstrate a decline in local bank competition, which then results in greater stability for rivals within the market. The reduction in competition does not appear to affect bank profitability.

The second chapter studies the differences in regulatory effectiveness across the three U.S. bank regulatory agencies. Since practices are rarely uniform across territories even within the same agency, I then examine the regional differences in regulatory effectiveness. I find that there exists large variations between agencies with respect to the efficacy of corrective sanctions. This heterogeneity persists even within the same agency, with evidence documenting broad disparity in the outcomes of intervention across districts. In discerning the reasons behind the differences, I provide evidence of the constrained cop hypothesis and show that stricter agencies are more effective at implementing sanctions.

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## Chapter 1

### Rival Response to Regulatory Intervention in Distressed Banks

Does a weak competitor breed aggression and increased competition, or higher pricing and passivity? In the banking industry, the answer is critical: regulators have the ability to guide and limit the actions of the banks under their purviews. As such, appropriate regulatory actions must take into account the effects of those actions both on the banks in question *and* on the broader industry. Since the explicit intent of enforcement actions is to correct behavior of unsafe banks<sup>1</sup>, corrective intervention can, in principle, overlook effects of such actions on peer institutions. The indirect impacts of regulatory enforcement on the competitive banking landscape may have as large an effect as the direct impacts, and perhaps not in the way intended.

In this paper, I show that the regulatory imposition of strictures on one bank in a local market results in "softer" competition by nearby rivals: industry concentration rises, output price elasticities relative to input cost decline, and the relationship between revenue and cost weakens. I demonstrate that this reduction in competition results in significantly greater local rival bank stability, with both Z-score<sup>2</sup> and bank equity increasing within local markets. Given that regulatory actions are intended to correct safety and soundness concerns within a single distressed bank, the concurrent decline in riskiness of competitors suggests that there are additional stability-enhancing effects of regulatory enforcement. Thus, if regulators do not take into account the effects on competitors, their actions may lead the local market to become overly risk-averse in aggregate. With clear changes in competition and bank risk, I explore the implications for local

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<sup>1</sup> The regulatory guide to enforcement actions clearly states that formal actions target only those banks participating in unsafe or unsound practices. <https://www.fdic.gov/regulations/safety/manual/section15-1.pdf>

<sup>2</sup> A standard measure of bank risk comparing return on assets to standard deviation of return on assets. For examples of Z-score used as the core measure of bank risk, see Demirguc-Kunt and Detragiache (2011) or Berger et al. (2009).

competitor profitability and find little evidence of performance changes, potentially due to competing forces (i.e. decline in competition and increase in stability) acting upon local banking markets.

To connect regulatory actions to subsequent changes in local competition and bank behavior, I generate a novel data set of hand collected corrective enforcement actions for U.S. banks from 2003 through 2013. I employ a difference-in-differences framework in order to estimate the behavior of rival banks following local intervention. I find empirical evidence demonstrating that local banks do strategically react to regulatory intervention, with a subsequent decrease in competition following the announcement of a formal enforcement action. Figure A.1, which plots the average price-cost elasticity in treated and untreated markets, suggests a strong effect of regulatory intervention on local competition. A high price-cost elasticity suggests greater competition, that is, changes in input costs result in similar pricing changes. As is evident in Figure A.1, the correlation of input costs and price drops for banks in local markets when one lender is subject to regulatory intervention. Other well-known measures of competition (e.g., Herfindahl-Hirschman Index, Competition Efficiency) tell a similar story.

Further exploring the decrease in competition, I demonstrate that the degree of competitive response changes depending on the financial condition of local banking markets. Those markets which are more financially distressed experience a much greater reduction in competition relative to markets which are less financially distressed. This finding follows the deep pockets hypothesis of competition, which posits that in certain circumstances, more financially sound firms will respond to a rival by increasing competition.<sup>3</sup> Although a regulatory action decreases competition on average, the effect is muted when local competitors are more financially sound.

I also explore the interaction between competition and risk and find a negative relationship. I measure bank risk through Z-score and bank equity, both of which capture the relative buffer a bank has against losses. A bank can utilize equity to withstand significant lending losses, while Z-score captures the number of standard deviations return on assets must decline in order to render the bank insolvent. Therefore, all else equal, the greater both Z-score and equity, the more financially stable the bank. I demonstrate a significant increase in Z-score and bank equity as competition declines. These findings are important as they speak

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<sup>3</sup> As described in Fudenberg and Tirole (1985) and Tirole (1988).

to the current debate regarding the effect of competition on stability, namely the competition-fragility and competition-stability hypotheses. Competition-fragility argues that competition makes banks more fragile, while competition-stability maintains the opposing view. My findings provide evidence in favor of the competition-fragility framework across multiple measures of both competition and bank risk.

Having established a decrease in local competition and an increase in stability, I then explore how performance changes for rivals of a bank subject to a regulatory action. Using return on assets (ROA) and return on equity (ROE) to capture profitability, I find no significant performance changes following intervention. The intuition relies on two contrasting tensions, on one hand, less competition should result in more monopolistic pricing and greater rents for the rival banks. On the other hand, if greater stability implies lower risk of default and risk of default is a component of overall risk, the all else equal, risk has declined, which implies a decline in performance. With two competing forces acting upon profitability, a clear relationship between competition and performance is not evident.

In determining strategic response and subsequent behavior given a weakened rival, my setting is relatively advantageous due to the strict guidelines of formal actions. Intervention stipulations often involve limits on branching, requiring regulatory approval for new lines of business, restrictions on credit to substandard borrowers, etc. Although not explicit, management may also self-impose other operational restrictions in order to meet regulatory directives. Thus, intervention clearly results in operational constraints of the risky bank.<sup>4</sup> Therefore, my identification strategy is built on the reduction in the competitiveness of a bank subject to intervention. This source of variation is a contribution to prior studies in other industries regarding firm distress and rival strategic behavior (e.g. Phillips, 1995; Chevalier, 1995). As regulatory intervention in a struggling bank is not designed to impact rival behavior, I am able to distinctively identify the relationship between the local market shock and strategic behavior. More narrowly, my setting also lets me address important banking specific questions regarding the impact of competition on bank behavior.

The rest of the paper is structured as follows. Section 2 discusses the hypotheses and provides an overview of the relevant literature. Section 3 outlines the regulatory enforcement action process. Section 4

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<sup>4</sup> Agarwal et al. (2014) also demonstrate that increased regulatory supervision results in greater costs. As enforcement actions are the most severe type of supervision, banks subject to intervention also take on additional costs.

presents the empirical design. Section 5 discusses the results and Section 6 concludes.

## 1.1 Related Literature and Hypothesis Development

A broad literature has focused on how financial distress and leverage impacts competition and firm behavior. Early empirical work by Opler and Titman (1994) demonstrates that when experiencing financial distress, levered firms lose market share relative to less levered peers. Confirming the relationship between capital structure and pricing, Phillips (1995) examines leveraged recapitalizations, finding either a significant positive or negative relationship between leverage and output and/or price, depending on the industry's prior characteristics. Using leveraged buyouts, Chevalier (1995) shows that, on average, rival supermarkets increase prices relative to a heavily indebted competitor and that leverage is inversely related to the competitive response of rivals. Finding alternative sources of distress, Borenstein and Rose (1995) explore the relationship between Chapter 11 bankruptcy and competition by examine the pricing choices of rivals around airline bankruptcy, finding no reaction by competing airlines to a bankruptcy. This lack of significant results suggests that airline bankruptcy is the result of a war of attrition, hence no significant rival response is expected. Table A.1 presents a summary of the prior literature exploring competitive response to distressed firms.

The mixed evidence regarding rival response to financially vulnerable firms demonstrates that the nature of strategic response is largely dependent on industry and individual firm attributes. Therefore, understanding local banking market characteristics is necessary in order to conjecture as to the type of response around enforcement action announcements. The classic industrial organization literature regarding strategic response to a distressed competitor advocates for merging with or acquiring the rival firm rather than engaging in price wars or predation (McGee, 1980; Tirole, 1988). Such an acquisition allows for continued rent extraction, whereas the alternative predatory response simply ensures that neither firm experiences profits. While combining with the distressed bank is potentially optimal, the strict banking regulatory environment may prohibit an initial acquisition of a troubled bank (regulators are keen to avoid overly concentrated local banking markets)<sup>5</sup>. Additionally, there is a chance that the corrective action was used to reduce unsafe

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<sup>5</sup> Although once a bank has failed, the regulators do step in and attempt to facilitate a merger with another bank.

business practices and the bank is somewhat financially sound, albeit risky. Thus the enforcement action temporarily reduces the competitiveness of the bank, allowing attentive rivals to respond aggressively and potentially further cripple the distressed bank. Alternatively, competitors may elect to reduce competitive behavior in an attempt to extract higher rents. I test the following hypothesis in order to understand how the significant regulatory barriers to acquisitions and the limitations imposed on a bank alter local competitor behavior:

***H1a:*** *Local banks do not strategically respond to a rival bank constrained by regulatory intervention.*

Contingent on a shift in competition, theoretical work on financially constrained competitors argues that more financially sound firms choose more aggressive strategic responses to distressed rivals (Fudenberg and Tirole, 1985; Telser, 1966). Empirically, Snider (2011) shows how large, relatively financially unconstrained airlines respond to weaker competitors in certain regional markets by slashing fares and incurring short term losses in an attempt to gain long run market share, lending support to the deep-pockets hypothesis. Cookson (2014) demonstrates that highly levered casinos are unable to strategically respond to new entrants, while less levered incumbents respond significantly. I examine this theory contingent upon strategic changes within the banking sector by testing the following hypothesis:

***H1b:*** *Given regulatory intervention in a struggling bank, more financially sound rivals do not alter strategic behavior differently than less financially sound peers.*

If there does exist a strategic response by local rival banks to a formal action, a number of studies provide insight into the motives for the reaction. Standard industrial organization research posits that the response could be driven by predatory behavior in an attempt to squeeze out the distressed firm. Alternatively, theoretical banking models propose that lenders elect to extend credit to borrowers based on the information regarding the borrower's quality (Stiglitz and Weiss, 1981; Mankiw, 1986; Sharpe, 1990). Since banks are unaware of the true borrower quality, but do know the distribution of borrower quality, an enforcement action against a local lender may serve as a signal to rivals about the distribution of borrower quality. Therefore, the competitive response could be the result of a reduction in information asymmetry and adverse borrower selection. If intervention is informative as to the nature of borrowers, local boom periods should result in a less pronounced competitive response, as borrowers are benefiting from economic gains and thus are better

able to repay their debts. In economic downturns, a local enforcement action announcement could be cause for alarm since the intervention is a signal that at least one competitor is unable to maintain adequate credit risk. Additionally, if regulatory actions is informative to the distribution of local borrower quality, rival banks may shift lending behavior in light of the intervention. Therefore, I test the forces motivating rival competitive response by examining the following hypotheses:

**H1c:** *In response to local regulatory intervention, rivals in stronger local banking markets do not alter competitive behavior more than weaker markets.*

**H1d:** *In response to local regulatory intervention, rival banks do not alter their lending behavior.*

As I use banking enforcement actions as the catalyst for strategic response, this study is also related to the large literature examining competition and the stability of financial institutions. Beginning with the competition-fragility framework of Marcus (1984), who suggests a negative relationship between competition and stability, researchers have been interested in understanding the mechanism behind market structure and bank risk. Formally, the competition-fragility hypothesis argues that banks facing increased competition experience lower profit margins and firm value. This decline in profitability results in increased bank risk taking. Keeley (1990) shows that the increase in competition resulting from state branching deregulation in the 1980s lead to lower profits and increased bank failures. Demsetz et al. (1996) establish a negative relationship between bank competition and stability by showing that banks in less competitive markets have higher franchise values and less portfolio risk. A number of other studies provide similar evidence in favor of the competition-fragility hypothesis for U.S. banks (Saunders and Wilson, 1996; Brewer and Saldenberg, 1996). Extending the idea to banking markets outside of the U.S., Hellmann et al. (2000) find that Japanese banks faced increase competition in the 1990s and subsequently experienced a decline in profitability and firm value. As a result, they suggest that the increased risk taking by Japanese banks was, in part, a reason for the East Asian financial crisis. More international evidence in favor of competition-fragility can be found in Salas and Saurina (2003) and Bofondi and Gobbi (2004), who examine banks in Spain and Italy, respectively.

More recently, many researchers have taken up the opposing competition-stability view. Introduced by Boyd and DeNicolo (2005), competition-stability suggests that market power is negatively related to bank

risk. As banks gain market power they charge higher interest rates which are more difficult for customers to pay. Facing potential default, customers shift towards riskier projects. As customers become riskier, banks experience more problem loans and a higher risk of failure. Therefore, decreased competition should result in higher interest rates and less stability. Boyd et al. (2006) provide empirical evidence supporting this hypothesis by showing that various measures of bank stability improve as markets become more competitive, both in local U.S. markets and between countries. More evidence can be found in DeNicolo and Loukoianova (2007) who confirm the link between competition and stability, but also show that the relationship is stronger after taking into account bank ownership. Cihak et al. (2006), in a study of 38 countries, find that more competitive banking markets have lower likelihoods of banks failure, therefore are more stable than less competitive environments.

Finally, Berger et al. (2009) study the interaction of market power and stability across 23 developed nations and present evidence in favor of both hypotheses. The authors argue that depending on banks' ability to mitigate risk, both frameworks can explain bank stability. This suggests that more research is needed to fully understand the relationship between bank competition and stability.

Although more recent research regarding market structure and bank risk has been in favor of the competition-stability framework, the fact that Berger et al. (2009) finds conflicting evidence using a broad set of competition and stability measures suggests that the relationship is somewhat dependent on a number of market and/or bank specific factors. Therefore, I test the following general hypothesis regarding banking market structure and stability, since either a positive or negative relationship is informative to the current debate:

**H2:** *A shift in competition within a local banking market does not result in a shift in local bank stability.*

While bank risk has been increasingly important, especially in light of the financial crisis of 2008-2010, researchers have also examined how bank market structure impacts performance. Applying the Structure-Conduct-Performance (SCP) framework (Bain, 1959) to banking markets, a body of work argues that concentration motivates bank profits. Much of the early work linking domestic banking market concentration to profits was mixed (for example, Rhoades, 1977; Rose and Fraser, 1976; Osborne, 1977;

Heggstad, 1979; Gilbert, 1984). Subsequent studies have applied the SCP framework to banking markets outside the U.S. Surprisingly, the results for the SCP hypothesis have been more favorable using international bank markets, with Molyneux and Teppett (1993), Molyneux (1993), Lloyd-Williams et al. (1994) finding evidence demonstrating that profitability and concentration are positively related.

Taking issue with SCP on a broader scope, an alternative literature has argued for a theory of competition based on the idea that concentration is not the driver of firm profits, but instead, efficiency dictates earnings (Demsetz, 1973; McGee, 1974; Peltzman, 1977; Brozen and Bittlingmayer, 1982). The efficient structure hypothesis suggests that firms with comparative advantages in production gain market share, and as a result, the market becomes more concentrated, allowing such firms to earn higher profits. Differentiating between types of efficiency, Berger and Hannan (1993) and Berger (1995) test two alternate versions of the efficient structure hypothesis, X-efficiency and scale-efficiency. X-efficiency argues that firms with superior management or technology have lower costs which result in higher profits, while scale efficiency assumes that management or technology are equivalent across firms but some firms are simply able to achieve lower costs due to scale economies, hence higher profits. In both cases, market power increases for more efficient firms. Findings favor the X-efficiency explanation of the efficient structure theory, while also providing no evidence in favor of the SCP paradigm.

With the many competing theories and results relating market structure to profitability, evidence of a precise correlation between market structure, efficiency, concentration, and bank profitability is lacking. I attempt to shed light on the relationship by examining local competing bank profitability around regulatory intervention.

## **1.2 A Primer on Bank Regulation and Enforcement Actions**

Banking industry regulation in the U.S. has developed into a system that is as broad as it is complicated. At the federal level, regulators include the Federal Reserve (Fed), Federal Deposit Insurance Corporation (FDIC), and the Office of the Comptroller of the Currency (OCC)<sup>6</sup>, each supervising a different type

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<sup>6</sup> Prior to 2012, the Office of Thrift Supervision (OTS) was responsible for oversight of savings banks and savings and loan institutions. Operations of the OTS were rolled into the OCC following the failure of Washington Mutual, AIG, and IndyMac.

of bank. The Fed regulates state-chartered banks if they elect to be members of the Federal Reserve System. Non-member state-chartered banks are subject to oversight by the FDIC. Finally, the OCC is the primary regulator of nationally chartered banks<sup>7</sup>.

Each regulator has similar resources available for maintaining effective supervision of member banks. Divided between on-site and off-site supervision, regulators have a number of tools available for monitoring banks. Off-site supervision requires banks to file quarterly financial reports, called Call Reports. Using these quarterly updates, regulators can monitor the financial conditions of the institutions between more rigorous on-site examinations. Visiting each bank allows regulators to verify Call Report information and examine the bank's condition in greater detail. The on-site exam allows regulators to not only confirm financial information, but also ensure compliance with regulations, meet with bank managers, and get a better sense of the overall condition of the bank by reading documents prepared specifically for the on-site visit.

The result of an on-site exam is the CAMELS (FDIC, 1997) rating, which is a composite rating of six components: capital adequacy, asset quality, management quality, earnings quality, liquidity, and sensitivity to market risk. The rating is on a scale of 1 to 5, with 1 being the highest rating a bank can achieve and 5 indicating severe operating deficiencies and serious risk of failure. CAMELS ratings of 1 and 2 are generally not cause for concern while CAMELS of 3, 4, and 5 indicate moderate to severe safety concerns. Since some aspects of the CAMELS rating are subjective (measuring management quality, for instance), the ratings are not completely indicative of the financial stability of an institution. A bank with a CAMELS of 3, for example, may be slightly less financially sound than a bank with a CAMELS of 4, but the bank with a 3 rating may have management that regulators deem more effective than the management at the 4-rated bank.

As bank financial performance deteriorates, regulators may elect to use an enforcement action in order to stop the further decline in bank safety and soundness (FDIC, 1997; Curry et al., 1999). Broadly, enforcement actions are regulatory stipulations requiring banks to take specific action(s), e.g., pay fines, remove management, reduce problem assets, increase equity, etc. They are divided into formal and informal actions, with formal actions being enforceable in court and publicly disclosed, while informal actions are

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<sup>7</sup> Information regarding oversight can be found on each regulatory agency's website: [www.federalreserve.gov](http://www.federalreserve.gov), [www.fdic.gov](http://www.fdic.gov), and [www.occ.gov](http://www.occ.gov)

less severe, private agreements between regulators and a bank. Formal *corrective* actions are a specific subset of formal enforcement actions that directly address the safety and soundness of a bank. As corrective actions are used to prevent further declines in already struggling banks, the stipulations of the action remain in place until one of two outcomes occurs: either the institution may fail to improve under the dictates or the corrections are made. Unsuccessful actions results in the bank closure, which involves reimbursing depositors up to the insurance limit (from the FDIC Deposit Insurance Fund) and then the FDIC acting as the Receiver of the failed bank. As Receiver the FDIC sells assets, settles debts, and may facilitate an acquisition of the failed bank. On the other hand, if the regulatory requirements are met then the formal enforcement action is removed, allowing the bank to once again operate autonomously. Table A.2 provides an overview of the actions available to bank regulatory agencies, with the actions in bold indicating the formal corrective actions used in this study.

As an efficient and functional regulatory system is a core component of a sound financial industry, understanding the costs and benefits of various types of supervision is crucial. Since becoming publicly available in 1989, researchers have explored the impact and effectiveness of formal enforcement actions on risky banks. Typically, the intention of such interventions is to improve the safety and soundness of troubled banks. Prior research has been largely consistent, with the majority of evidence demonstrating increased bank safety following the implementation of an enforcement action,<sup>8</sup>

## **1.3 Data and Empirical Design**

### **1.3 Enforcement Action Data**

I collect only those type of enforcement actions that have been shown to influence bank behavior. From Delis et al. (2013), formal actions unrelated to safety and soundness are found not to alter bank behavior. These types of actions include civil money penalties and suspension or removal of bank affiliates (either permanent or temporary). I also exclude termination of deposit insurance, as these actions are extremely

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<sup>8</sup> For example, Peek and Rosengren (1995), FDIC (1997), and Curry et al. (1999) show that formal actions reduce lending and asset growth. Gilbert and Vaughan (2001) find no changes in deposits for banks under enforcement actions. Manser (2014) finds evidence of improvement in bank safety even after an enforcement action ends.

rare and only used in the most dire of situations, e.g., when a bank's behavior has been so egregious that the only regulatory course of action is essentially a death sentence. The actions used in this study include cease and desist orders, consent orders, formal agreements, prompt corrective actions, and written agreements. A summary of action types can be found in Table A.2.

With the type of action defined, corrective enforcement announcements are hand collected from the Fed, FDIC, and OCC enforcement action databases.<sup>9</sup> From the formal actions available on the regulatory websites I note the bank, start date, and type. As the enforcement actions only list the bank name, I then match the name to the bank identification number (RSSID) using a combination of a matching algorithm<sup>10</sup> and hand matching. In total, I collect 2,749 corrective action announcements from the Fed, FDIC, and OCC from 2003 to 2013. The sample period was selected due to availability of bank financial data. I remove updates or modifications to formal actions, which are part of the total number of announcements. I also eliminate enforcement actions against banks which are part of a multi-bank holding company in order to reduce any potential confounding effects. The resulting sample is reduced to 1,173 formal corrective actions. Another 51 actions could not be matched to Call Report data and were subsequently dropped. 19 were removed due to missing location information, leaving 1,103 unique corrective actions.

Treated markets are identified as those in which one bank is subject to a formal corrective action. The control markets are those counties within the same state as the treated market with the same number of banks, with those banks being of similar size. I allow treated markets to be included in the control group for an alternative event so long as the treatment dates are eight or more quarters apart.

In order to ensure the most accurate results, I require clean treatment and control market. A clean treatment observation is identified as a market which has only one bank subject to a formal action for the previous eight quarters and subsequent eight quarters. In order to be a control market, there must be no bank subject to an enforcement action over the sixteen quarter period surrounding the event date. 619 of these observations are removed from the sample so as to ensure consistent estimates.

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<sup>9</sup> Fed: [www.federalreserve.gov/apps/enforcementactions/search.aspx](http://www.federalreserve.gov/apps/enforcementactions/search.aspx)

FDIC: [www5.fdic.gov/edo/DataPresentation.html](http://www5.fdic.gov/edo/DataPresentation.html)

OCC: [apps.occ.gov/EnforcementActions/](http://apps.occ.gov/EnforcementActions/)

<sup>10</sup> Python's Natural Language Toolkit (NLTK) libraries were implemented in order to match the bank name from the enforcement action to the bank identification number in the Call Report database.

In defining a local banking market, my core specification deviates slightly from prior research by classifying the local market as the county in which the bank is headquartered. While the standard in bank market structure research is to group by metropolitan statistical areas (MSAs) or non-metropolitan counties (Jackson, 1992; Whitehead, 1990), I elect to use the county lines as the market definition in order to be as precise as possible in estimating competitive reactions to intervention. Since many MSA counties are removed from the sample due to overlapping events, the majority of the event markets are rural. Defining markets for more rural banks as just non-metropolitan area results in markets that are unrealistic in that the market extends well beyond a bank's reach. The altered definition of a local banking market results in 484 unique observations.

The first table in Appendix A.2 defines local banking markets as the MSA in which a bank is headquartered. The second table leverages bank branching locations from the Summary of Deposits database and constructs treated markets as the county in which the bank subject to sanctions has a branch. Any bank headquartered within those counties is classified as a local competitor. The control regions associated with the branching markets are defined as the single counties which most closely resemble the full treated market.

Quarterly bank accounting information comes from the FDIC's Call Report database. All variables are winsorized at the 1% level to reduce the effect of outliers. Summary statistics for the full sample and treatment counties can be found in Table A.3.

### **1.3 Measuring Bank Competition**

In order to capture competition within banking one must understand the relationship between costs and prices. Theoretically one could capture the degree of competition by comparing marginal costs to marginal revenues. In practice, however, observing the marginal cost and revenue curves is far from trivial. Therefore, I implement a number of competitive measures in order to establish a clear relationship between the cost and price of banks within local markets.

I begin my analysis of local banking competition with the Panzar and Rosse H-Statistic (Panzar and Rosse, 1987) which estimates the change in price relative to the change in cost, or the elasticity of prices with respect to costs. The H-Statistic estimates a revenue function,  $\ln TR_i = g(\ln P_i, \ln Q_i)$ , where  $TR_i$

is total revenue,  $P_i$  represents observed input prices, and  $Q_O$  is a constant level of output. Intuitively, the measure illustrates the degree of change in output price to the change in input price. If output prices and input costs move in unison the market is more competitive since cost determines price. The H-Statistic is bounded above by 1, with numbers equal to or less than 0 indicating an inelastic relationship between input cost and output price, and therefore a less competitive market. An H-Statistic between 0 and 1 suggests a positive relationship between input cost changes and output price changes, and an H-Statistics approaching 1 shows an increasing elastic relationship between cost and price, and thus greater competition.

In order to calculate the H-Statistic, I estimate the the translog revenue equation:

$$\begin{aligned} \ln TR_{it} = & \alpha + \beta_1 \ln FC_{it} + \beta_2 \ln CL_{it} + \beta_3 \ln CFA_{it} + \gamma_1 \ln LNS/TA_{it} \\ & + \gamma_2 \ln NEA/TA_{it} + \gamma_3 \ln DEP/TL_{it} + \gamma_4 \ln CAP/TA_{it} \\ & + \gamma_5 \ln OI/II_{it} + \epsilon_{it} \end{aligned} \quad (1.1)$$

The dependent variable  $TR_{it}$  is total revenue, or the sum of interest income and non-interest income, for bank  $i$  in quarter  $t$ <sup>11</sup>. Although there are a number of specifications of the bank revenue function, Bikker et al. (2006) demonstrate that un-scaled *Total Revenue* as the dependent variable results in an unbiased H-Statistic, whereas using the more prevalent revenue or interest income scaled by assets leads to a positively biased H-Statistic.  $FC_{it}$  capture the funding costs of the bank, measured by interest expense.  $CL_{it}$  is the cost of labor, calculated by employee expenses per employees.  $CFA_{it}$  is the ratio of fixed asset expense to fixed assets. Collectively, these three cost measures capture the core input costs of the bank. The revenue function also takes into account the asset and funding mix, with  $LNS/TA_{it}$  measuring the ratio of loans to assets, while  $NEA/TA_{it}$  is the portion of non-earning assets to total assets.  $DEP/TL_{it}$  is deposits to total liabilities, which accounts for funding differences across banks.  $CAP/TA_{it}$  is the capital to asset ratio which measures different levels of leverage, helping control for different risk profiles. Finally,  $OI/II_{it}$  controls for the fact that many banks are generating an increased portion of revenue from non-core activities by dividing other income by interest income.

The H-Statistic revenue equation is estimated in a panel setting for each event/region and calculated

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<sup>11</sup> All variables used to estimate the H-Statistic are detailed in Appendix A.1. All bank financial information comes from the quarterly FDIC Call Report database.

as follows:

$$H - Statistic = \beta_1 + \beta_2 + \beta_3 \quad (1.2)$$

Supplementing the prominent H-Statistic, I include a relatively new measure of competition, Competition Efficiency (CE).<sup>12</sup> CE is a relative measure of competition, comparing the bank closest to the cost-price frontier to all other banks in the market. The idea begins with a function of bank profits:

$$\Pi = f(\text{competition}, \text{costs}) \Rightarrow \frac{\text{revenue}}{\text{costs}} - f(\text{costs}) = g(\text{competition})$$

where  $g(\text{competition})$  is the unexplained markup of prices over costs. The smaller the difference between revenues and costs, the more competitive the market. In order to calculate competition in the CE framework, I estimate the following translog revenue function:

$$\begin{aligned} \ln RevRatio_{it} = & \alpha + \beta_1 \ln Q_{it} + \frac{\beta_2}{2} \ln Q_{it}^2 + \gamma_1 \ln CL_{it} + \gamma_2 \ln CFA_{it} \\ & + \gamma_3 \ln CL_{it} \ln CFA_{it} + \lambda_1 \ln Q_{it} \ln CL_{it} + \lambda_2 \ln Q_{it} \ln CFA_{it} \\ & + \omega_1 \ln DEP/BR_{it} + \omega_2 \ln L/BR_{it} + \frac{\omega_3}{2} \ln DEP/BR_{it} \ln L/BR_{it} \quad (1.3) \\ & + \delta_1 \ln CAP/TA_{it} + \delta_2 \ln LLL_{it} + \delta_3 \ln CAP/TA_{it} \ln LLL_{it} \\ & + \theta_1 \ln RATE_t + \ln e_{it} + \ln u_{it} \end{aligned}$$

where  $RevRatio_{it}$  is the ratio of bank revenue to operating costs,  $Q_{it}$  is bank output as proxied by total assets,  $CL_{it}$ ,  $CFA_{it}$ , and  $CAP/TA_{it}$  are the same variables used in the H-Statistic equation, while  $DEP/BR_{it}$  and  $L/BR_{it}$  measure average deposits and labor costs per branch in order to control for the productivity of each bank location.<sup>13</sup> The final bank specific covariate,  $LLL_{it}$ , is the provision for loan and lease losses ratio which, along with  $CAP/TA_{it}$ , controls for bank risk.  $RATE_t$  is the 3-month Treasury bill rate, included to control for the cost of funds which impacts the rate on both deposits and loans. As in the H-Statistic equation,  $i$  represents each bank and  $t$  the time period.

The total error term is  $\ln e_{it} + \ln u_{it}$ , which can be divided into the normal error portion ( $\ln e_{it}$ ) and the error due to inefficiency ( $\ln u_{it}$ ). As Equation (4) is estimated using the Distribution Free Approach

<sup>12</sup> Competition efficiency was first introduced theoretically by Boone (2008) and subsequently examined empirically by Bolt and H. (2012) and Schaeck and Cihak (2014)

<sup>13</sup> Branch data comes from the FDIC Summary of Deposits survey.

(DFA) (Berger, 1993), which assumes the average of the error term  $\ln e_{it}$  will be very close to zero, the residual is  $\ln u_{it}$ , or the average effect of competition. The idea behind CE is that the firm with the lowest  $\ln \bar{u}_{min}$  is the firm where costs most fully explain revenues, suggesting increased market discipline on the relationship between revenues and costs. The further away  $\ln \bar{u}_{it}$  is from this minimum value, the less revenue is explained by costs.

In estimating CE for bank  $i$  in period  $t$ , the residual  $\ln \bar{u}_{it}$  is compared to  $\ln \bar{u}_{min}$ . The formula for CE is:

$$CE_{min} = e^{\bar{u}_{it} - \bar{u}_{min}} - 1 \quad (1.4)$$

Therefore  $CE$  is bounded below by zero, indicating that a bank is as efficient as the most efficient bank in the market. The more banks that become more efficient, the greater the competition. If  $CE_{min} = 1$  then the impact of competition on the revenues of bank  $i$  is 100% greater than that of the most competitive bank. As CE is a relative measure to the most efficient bank, the further a bank deviates from  $\ln \bar{u}_{min}$ , the less influence competition has at limiting bank revenues compared to costs.

The final measure of competition used in this paper is the deposit based Herfindahl-Hirschman Index (HHI), which determines the concentration of deposits for each local market. The HHI measures concentration rather than pure competition, but many argue should be correlated with competition. Due to the simplicity of calculation and ease of intuition, the HHI has been firmly established as a tool of policy makers and regulators in assessing competition. The formula used for HHI is as follows:

$$HHI_{kt} = \sum_i s_{it}^2 \quad (1.5)$$

where  $s_{it}$  is the market share of either deposits or loans for bank  $i$  in period  $t$ . Market share is calculated for each local market,  $k$ , as bank  $i$ 's deposits or loans divided by the sum of all deposits or loans in the county for period  $t$ .

Summary statistics for measures of local competition can be found in Table A.4. The mean level of competition for each measure is similar to prior studies (for example, Bikker and Haaf, 2002; Bolt and H., 2012). Table A.5 presents the average measures of competition for the control and treated groups, before and after treatment for the full sample, before the financial crisis (2003-2007), during the crisis (2008-2010),

and through the recovery period (2011-2013).

### 1.3 Empirical Design

The first step in my analysis is determining the competitive response of local banks to an enforcement action against a rival bank. Exploiting the public disclosure of formal regulatory decisions and prior research suggesting that banks subject to enforcement action not only face increased costs but also significantly alter their behavior, I estimate the response of local rivals by implementing a difference-in-differences approach.<sup>14</sup> Since enforcement actions do not occur at the same time, I use the two step method of estimating difference-in-differences with rolling treatments from Bertrand et al. (2004). The sample is a cross-sectional time-series, set up in event-time, of eight quarters before and eight quarters after the enforcement action announcement. The first stage involves estimating the following panel regression:

$$Y_{kt} = \alpha + \beta X_{kt} + \gamma Z_t + \phi R_k + \varepsilon \quad (1.6)$$

where  $Y_{kt}$  is the measure of competition: H-Statistic, Competition Efficiency, and Deposit HHI.  $X_{kt}$  is the vector of relevant control variables,  $Z_t$  are time dummies,  $R_k$  is the region dummy. The residuals for the only treated observations are stored and separated into *before* and *after* the treatment. The second stage regression involves averaging the pre- and post-period residuals and estimating the following regression:

$$Y_k = \alpha + \beta \textit{after} + \varepsilon \quad (1.7)$$

Where  $Y_k$  represents the residuals from the first stage regression for only the treated counties and *after* is a binary variable representing either the pre- or post-treatment period. As the second stage regression includes only the residuals from treated observations, the coefficient on *after* identifies the average competitive response of banks in the treated counties. As discussed in Bertrand et al. (2004), collapsing the panel by averaging the pre- and post-period ensures correct standard errors.

Banking theory suggests that shifts in the competitive structure of the market should result in changes to bank behavior. In order to measure the change in rival bank behavior I estimate Equations (7) and (8)

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<sup>14</sup> I choose this approach as DID has a rich history in estimating the effect of distinct economic regime changes (for example, see Angrist and Krueger, 1999; Lemmon and Roberts, 2010)

with ROA, ROE, Z-score, and bank equity as dependent variables in the the first stage regression, including firm fixed effects. These measures allow me to detect any shifts in profitability and stability around changes in competition.

## 1.4 Empirical Results

### 1.4 Competitive Response

Table 6 presents the core results for local competitive response to an enforcement action. Each column presents the estimation of one measure of competition as the dependent variable in the first-stage estimation, with the treated region residuals as the dependent variable for the second stage. Two of the three measures of competition are statistically significant, with H-Statistic and  $CE_{min}$  suggesting a weakening of competition following enforcement against a weakened competitor.

The first two columns of Table A.6 examines the change in the H-Statistic around enforcement, documenting a significant decline in the measure, even after controlling for the impact of credit unions. A reduction in the H-Statistic indicates a more inelastic relationship between input costs relative to output prices within local markets. The  $treat \times after$  coefficient for the H-Statistic is -0.1902, significant at the 1% level, in the absence of credit unions. After including the number of credit unions as a control, the  $treat \times after$  coefficient actually becomes more negative, -0.2044 significant at the 1% level. As the mean H-Statistic is 0.5062 for all local markets and 0.4861 for treated counties, this -0.2044 represents an economically significant change in the price-cost elasticity within local banking markets.

Confirming the decline in competition, the  $treat \times after$  coefficient for  $CE_{min}$  in Columns 3 and 4 of Table A.6 are 0.0808 and 0.0507%, significant at the 1% and 10% levels. These coefficients indicates that competing banks in the treated counties became 5.07% less efficient on average relative to the most efficient bank in the region, in the precense of credit unions.

Alternatively, Columns 5 and 6 demonstrate no significant increase in deposit HHI. This finding is relatively unsurprising, since Gilbert and Vaughan (2001) demonstrate no significant changes in deposit levels or deposit pricing within banks subject to enforcement actions, suggesting that consumer fears are

alleviated by deposit insurance. Interestingly, the deposit HHI specification is the only model in which the credit union control loads. As credit unions are largely focused on consumer rather than commercial financing activities, the deposit HHI being influenced by the number of credit unions in the market is a logical result.

Taken together, the change in the H-Statistic and CE demonstrate a clear weakening of local competition following a rival bank being subject to corrective regulatory intervention, therefore allowing me to reject *H1a* in favor of the alternative hypothesis. The shift in local deposit behavior combined with the change in the H-Statistic and CE measures also provide insight into the actual behavior of rivals following local regulatory intervention. As the H-Statistic and CE both estimate bank revenue functions and deposits are becoming more concentrated within the local banks not subject to regulatory intervention, the decline in competition may be the result of a decline in funding costs. I explore this idea further, as well as other aspects of bank behavior in subsequent sections.

In order to understand whether the recent financial crisis had a significant impact on the competitive response, Table A.7 divides the sample into three distinct time period. Panel A spans from 2003-2007, Panel B analyzes the crisis period between 2008-2010, and Panel C examines the recovery from 2011-2013. The findings of Table A.6 are generally confirmed in Panels A and B of Table A.7, although the some measures of competition fail to load in different time regions while alternative specifications confirm market behavior.

Table 8 expands the analysis by examining the degree of competitive response given the financial stability and soundness of the banks within the local market prior to the intervention. Splitting the sample by capital to assets allows for a test of *H1b*, or the deep-pockets hypothesis. If the hypothesis can be rejected, the treated counties with higher levels of capital to assets before the corrective action should experience the less of a decrease in competition, as banks in such counties are better able to bear the potentially lower profits from more competitive environments.

Panel A of Table A.8 divides the sample into two groups relative to the median level of capital to assets in the treated county before the enforcement action. The post-period coefficients in Panel A are largely similar to the results of the full sample, indicating an overall decline in competition. Beginning with the H-Statistic, Column 1 in Panel A of Table A.8 demonstrates that local banking markets that were relatively

financially unstable experienced a significant reduction in competition, or a 21.67% decline in price-cost elasticity. Panel B shows a similar change in H-Statistic, but to a lesser extent, with the  $\text{treat} \times \text{after}$  coefficient suggesting a slightly smaller decline in competition and less statistically significant. The findings in Table A.8 regarding  $CE_{min}$  indicate a reduction in competition for the more financially constrained counties, and no reduction in competitive behavior for those less constrained counties. Although not statistically significant, the  $\text{treat} \times \text{after}$  deposit HHI coefficients are of the correct magnitudes given the two types of markets. This stark difference in response between the two types of counties clearly shows that less financially stable markets shift to much weaker competition relative to their more financially stable counterparts, lending support to the deep-pockets hypothesis and the rejection of *H1b*.

The results in Table A.9 present the findings of intervention on the relative vibrancy of the local or overall banking market. Using the Zillow Home Value Index (ZHVI)<sup>15</sup> at the county, state, and country level, I argue that the strength of the banking industry is highly correlated with that of the housing market (one needs to simply follow the performance of banks before and during the 2008 financial crisis for anecdotal confirmation of this idea). The ZHVI is a proprietary housing index developed by Zillow which is intended to closely track the Case-Schiller index but allow for more granular observations. The goal of exploring rival bank behavior in strong or weak banking markets is to better understand the type of rival response. If bad markets result in greater competitive declines, the enforcement decision could just be signalling to the rival banks that they may need to reign in their behavior so as to avoid regulatory sanctions. Alternatively, if bad banking markets result in greater competition, the reaction is likely a strategic reaction to the weakened competitor in an attempt to squeeze the constrained bank out of the already suboptimal banking market.

Interacting the housing market variable with the  $\text{treat} \times \text{after}$  indicator captures the effect of being in a marginally better local, state, or country housing market, and thus a similar banking environment. Panel A of Table A.9 present the interaction of intervention on region. The  $\text{treat} \times \text{after}$  coefficient is significant regardless of the region interaction and in the expected direction. The interaction with county-level housing market is insignificant, as is the country-level interaction. The marginal effect of the state housing market on

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<sup>15</sup> Zillow Home Value Index data comes from [www.zillow.com/research/data/](http://www.zillow.com/research/data/).

intervention is significant though, demonstrating that as the state housing market improves (and likely the state banking environment), the degree of less competitive behavior following intervention is reduced even more. The findings in Panel A are corroborated by the results of shifts in  $CE_{min}$  following intervention, with better county and national banking markets resulting in a greater weakening of competitive behavior. Finally, Panel C shows that after controlling for the national banking market, deposit concentration increase, and increases to a greater extent given a stronger national banking market.

These findings are somewhat surprising but not entirely unreasonable. The response could be nothing more than rational decisionmaking from a bank manager perspective. If a bank going under regulatory sanctions results in less competitive behavior by rivals in an attempt to focus internally and reduce the chances of an intervention, a more vibrant banking market means that the degree of competition can be reduced even further, since the market is already strong.

Table 10 examines how the characteristics of the sanctioned bank influence the resulting competitive shift. If the bank under the enforcement action is the largest bank in the market or a relatively insignificant competitor within the local market, the type of rival response may be different. The findings suggest that after controlling for the size of the bank under an enforcement action, the cost-price elasticity is reduced even further but no marginal impact of sanctioned bank size. Alternatively, there is no longer any shift in  $CE_{min}$ , although the larger the sanctioned bank, the more competitive the local market, on average. The last three columns of Table A.10 control for sanctioned bank deposits rather than assets. The results are nearly identical.

#### **1.4 Bank Behavior and Competition**

I now turn my analysis towards bank stability following a change in competition as a result of a formal enforcement action documented in Tables A.11 and A.12. Table A.11 explores the change in Z-score and bank equity following treatment, with results showing that both measures of stability increase. The positive and significant post-period coefficient for Z-score suggests that following a rival being subject to regulatory intervention, local competing banks would need to experience a larger decline in ROA in order to become insolvent than before the action. Similarly, local competitor bank equity experiences a positive and

significant shift following regulation actions, which implies that these banks are better able to bear potential losses, thus becoming more stable. The results in Table A.11 allow me to reject the null hypothesis  $H_2$ , in favor of the alternative hypothesis of stability be effected by competition.

The change in stability is informative to the type of competitive shift. Rather than strategically attempt further harm the troubled rival, banks seem to view regulatory intervention as a warning. Able to see the problems of the bank subject to the enforcement action and the subsequent operational constraints and added costs, the results seem to suggest that local banks tend to try and avoid similar intervention. As formal corrective actions are intended to improve the safety and soundness of the risky bank, the fact that local rivals actually become more stable is a positive externality of intervention.

Besides demonstrating the broader benefits of regulatory supervision, the results provide evidence in favor of the competition-fragility framework. I demonstrate a clear decrease in competition and deposit concentration combined with an increase, across two core measures, in bank stability. I differ from the standard competition-fragility theory, though, which posits that pricing leads to changes in bank risk taking and therefore stability. My setting argues that conscious bank decisions to bolster equity is the driving force behind the relationship between competition and bank stability. As demonstrated by Berger et al. (2009), the findings are largely dependent on the type of competition measured, type of stability measured, and type of market. I demonstrate that the reason behind a competitive shift could also result in differing relationships between bank competition and stability.

Table A.12 examines the relationship between competition and performance, finding no significant evidence of a change in bank profitability between ROA or ROE. As competition decreased, the expectation is that firms in the local market become more profitable. While this may actually be occurring, the shift towards greater safety in the local treated markets argues that bank profits should decline in order to conform with the standard risk-reward relationship. So while profitability could be increasing due to a less competitive local market, the effect is difficult to untangle from the simultaneous decline in performance given greater stability.

## 1.5 Conclusion

The purpose of formal corrective actions is to improve the safety and soundness of struggling banks. This study demonstrates that there are indirect effects of these regulatory interventions. The announcement of an enforcement action publicly verifies the weakened state of a bank, but also clearly demonstrates to attentive competitors the severe penalties for being too risky. I show that local competing banks respond to these actions by decreasing competition within the local market. The degree to which local competition decreases is related to the financial health of the banks within the market, providing empirical evidence in favor of the deep-pockets hypothesis of strategic response.

With this shift in competition, I also provide evidence on the relationship between bank competition and behavior. Specifically, the results of stability following the change align with the competition-fragility theory. The decline in competition is not met similar changes in performance. While there could be profitability increases due to the less competitive markets, the results may be clouded by the simultaneous reduction in profitability as a result of less risk. This effect could be temporary, though, and additional research is needed to fully understand the spillover effects of formal enforcement actions.

The decline in performance, increase in stability, and lack of change in performance for local competitors around regulatory intervention poses additional research questions. Specifically, the impact of competition on pricing. More precise data is needed to fully examine the question, but results would be informative to competitor strategic response and performance around regulatory actions. Additionally, how long do the contagion effects of intervention persist? Once the bank subject to corrective actions has sufficiently improved, does the market revert to conditions before treatment, or is the change in fact a new equilibrium? In order to more completely understand the behavior of rival banks around regulatory intervention, these questions must be addressed.

## Chapter 2

### A Method to the Madness? Exploring Bank Regulatory Regimes

The banking industry within the United States has long been subject to complex and ever-changing regulatory guidelines. As was evident in the aftermath of the financial crisis beginning in 2008, there is a genuine need for sound banking supervision and effective regulatory design. Although hardly a shocking revelation, the fact that the bank regulatory environment within the U.S. is split between three autonomous federal agencies suggests that fully understanding supervisory efficacy requires an examination of not just the aggregate process, but also the differences between the agencies.<sup>1</sup> Therefore, in order to better understand the regulatory process, I ask the following questions: Does effectiveness of bank supervision vary across regulators? As regulators divide the country into sub-districts, are there large differences in regulatory performance within the same agency but across regions? If supervisory effectiveness is heterogenous across agencies and/or districts, what can be learned by these differences so as to improve the regulatory design of the banking industry?

With the banking industry playing such a crucial role in the broader economy, the answers to these questions are of significant importance as regulators wield a great deal of power over the institutions under their purviews. This power is observed through a number of avenues and while the broader regulatory environment implements general guidelines for the entire industry, regulators have the ability to directly intervene in troubled banks through the use of enforcement actions. As the enforcement action powers are uniform across regulators, examining how agencies deal with their most distressed constituents through the use of these actions allows me to pinpoint and understand any heterogenous effects of the bank supervisory

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<sup>1</sup> During the sample period there were four regulatory agencies, with the Office of Thrift Supervision being shut down following the financial crisis.

process.

To examine the differences in intervention efficacy, both across and within regulators, I construct a new data set of bank enforcement actions that not only spans agencies but documents the entire timeline of the action, from 2003 to 2013. Using a propensity score matched difference-in-differences approach, I am able to compare those banks that were subject to regulatory enforcement to similar banks that narrowly avoided formal actions. The core findings demonstrate that there are significant disparities between agencies regarding the stability and performance of a distressed bank following the use of an enforcement action. Within agencies I also document large differences across districts, suggesting that the relative latitude given to regulators in their use of formal enforcement actions has a large impact on the resulting safety of the overall banking industry. Finally, I show how the characteristics of each regulatory agency influences the overall outcome of the interventions. Taken together, the findings presented in this paper suggest that effective regulatory design is far from straightforward, with many factors influencing whether or not intervention in a distressed bank will ultimately be successful.

Since the stated goals of regulatory supervision and enforcement of banks within the U.S. are equivalent across agencies, finding considerable differences in the outcome of such actions between regulators is somewhat surprising. Using Z-score<sup>2</sup> and bank equity as measures of stability, I find that Federal Reserve (Fed) member banks subject to intervention become much more stable relative to those banks which narrowly avoided formal sanctions, experiencing a 48.04% increase in Z-score after regulatory intervention. This increase is in contrast actions used with banks regulated by the FDIC and the OCC, in which the Z-score following intervention is 24.67% and 0.00% higher relative to other troubled banks free from corrective actions. Figure B.1 demonstrates the differences in stability between the treated and control banks, while Figure B.2 provides a clear graphical interpretation of the intervention efficacy differences between agencies. I also examine how bank performance is effected by the use of a corrective action, with evidence largely in line with the stability results.

Inquiring further into the use of enforcement actions against distressed banks, I move beyond the

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<sup>2</sup> A standard measure of bank risk comparing return on assets to standard deviation of return on assets. For examples of Z-score used as the core measure of bank stability, see Demirguc-Kunt and Detragiache (2011) or Berger et al. (2009).

regulatory differences and focus on the intra-agency variation in intervention efficacy. Since each regulator divides the U.S. into separate districts (see Figure B.2 for an overview of each district by agency), my goal is to distinguish regions or offices that are more effective at implementing enforcement actions from those that are less diligent, even after controlling for regional differences. Across all agencies I find that there are differences between districts. Within the Fed, the results suggest that most regional offices are extremely effective at implementing enforcement actions, while only three of the ten offices (two offices, Boston and New York, did not have enough data to be included) experience null or negative results for stability. Within the FDIC, four of the eight districts were effective at improving bank stability beyond that of the unsanctioned banks, while distressed banks in the remaining regions were no worse off as a result of intervention relative to banks not experiencing the enforcement actions. Finally, within the four OCC districts, the stability results were divided between one effective region (*Central*), one ineffective region (*Southern*), and two null regions (*Western* and *Northwestern*).

While the central findings thus far have uncovered interesting relationships both across and within bank regulatory agencies regarding the effectiveness of intervention, they do little to help understand why these differences exist, especially given the similar nature and overall goal of each distinct group. In attempting to explain why enforcement action efficacy differences exist, I use agency specific data and information regarding the type of bank supervised by each regulator to better understand what areas are most critical to an effective regulatory framework. The most striking difference between the regulators is the number of banks supervised by each group. There is a strict negative relationship between the number of banks and intervention efficacy, providing evidence of the constrained cop theory of supervision. Beyond simply number of banks per agency, the number of field offices and distance to these offices plays a role in how effective an enforcement action will be, which corroborates past research that finds strong relationships between location and bank supervision.

While effective banking regulatory design has historically been an important topic, the global finance crisis of 2008 thrust the issue back into the spotlight. With the intricate financial institution regulatory system within the U.S., divided between three independent agencies, there is a lack of research examining the differences between the organizations. The results presented in this paper provide the first evidence of

distinct differences in effectiveness of U.S. bank regulators. Further findings point towards potential policy implications that stem from this heterogeneity. The rest of the paper is structured as follows. Section 2 discusses the bank supervisory environment within the U.S. and the regulatory enforcement process. Section 3 presents related literature which is used to develop the hypotheses. Section 4 explains the data and empirical specification. Section 5 discusses the findings and any policy implications, while Section 6 concludes.

## **2.1 Bank Regulatory Environment**

The bank supervisory system within the U.S. is highly fragmented, with banks being regulated at the federal and state level. Depending on the type of charter, a bank can have one of three primary federal regulators, the Federal Reserve (Fed), Federal Deposit Insurance Corporation (FDIC), or the Office of the Comptroller of the Currency (OCC).<sup>3</sup> The Fed regulates state-chartered banks if they elect to be members of the Federal Reserve System. Non-member state-chartered banks are subject to oversight by the FDIC. Finally, the OCC is the primary regulator of nationally chartered banks<sup>4</sup>.

Each regulator has similar resources available for maintaining effective supervision of member banks. Divided between on-site and off-site supervision, regulators have a number of tools available for monitoring banks. Off-site supervision requires banks to file quarterly financial reports, called Call Reports. Using these quarterly updates, regulators can monitor the financial conditions of the institutions between more rigorous on-site examinations. Visiting each bank allows regulators to verify Call Report information and examine the bank's condition in greater detail. The on-site exam allows regulators to not only confirm financial information, but also ensure compliance with regulations. The examiners meet with bank managers as they evaluate the overall condition of the institution (e.g., loan file reviews, evaluations of key assumptions used in accounting and risk models, etc.).

The result of an on-site exam is the CAMELS (FDIC, 1997) rating, which is a composite rating of six components: capital adequacy, asset quality, management quality, earnings quality, liquidity, and sensitivity

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<sup>3</sup> Prior to 2012, the Office of Thrift Supervision (OTS) was responsible for oversight of savings banks and savings and loan institutions. Operations of the OTS were rolled into the OCC following the failure of Washington Mutual, AIG, and IndyMac.

<sup>4</sup> Information regarding oversight can be found on each regulatory agency's website: [www.federalreserve.gov](http://www.federalreserve.gov), [www.fdic.gov](http://www.fdic.gov), and [www.occ.gov](http://www.occ.gov)

to market risk. The rating is on a scale of 1 to 5, with 1 being the highest rating a bank can achieve and 5 indicating severe operating deficiencies and serious risk of failure. CAMELS ratings of 1 and 2 are generally not cause for concern while CAMELS of 3, 4, and 5 indicate moderate to severe safety concerns. Since some aspects of the CAMELS rating are subjective (measuring management quality, for instance), the ratings are not completely indicative of the financial stability of an institution. A bank with a CAMELS of 3, for example, may be slightly less financially sound than a bank with a CAMELS of 4, but the bank with a 3 rating may have management that regulators deem more effective than the management at the 4-rated bank.

As bank financial performance deteriorates, regulators may elect to use an enforcement action in order to remediate performance weaknesses identified in the exam (FDIC, 1997; Curry et al., 1999). Broadly, enforcement actions are regulatory stipulations requiring banks to take specific action(s), e.g., pay fines, remove management, reduce problem assets, increase equity, etc. They are divided into formal and informal actions, with formal actions being enforceable in court and publicly disclosed, while informal actions are less severe, private agreements between regulators and a bank. Formal *corrective* actions are a specific subset of formal enforcement actions that directly address the safety and soundness of a bank. As corrective actions are used to prevent further declines in already struggling banks, the stipulations of the action remain in place until one of two outcomes occurs: either the institution may fail to improve under the dictates or the corrections are made. Unsuccessful actions result in bank closure, which involves reimbursing depositors up to the insurance limit (from the FDIC Deposit Insurance Fund) and then the FDIC acting as the Receiver of the failed bank. As Receiver, the FDIC sells assets, settles debts, and may facilitate an acquisition of the failed bank. On the other hand, if the regulatory requirements are met then the formal enforcement action is removed, allowing the bank to once again operate autonomously.

## **2.2 Related Literature and Hypotheses**

Since each agency performs largely the same function and has nearly identical options for maintaining safety and soundness within the banking industry, each should behave similarly in regards to the use and effectiveness of enforcement actions. As an efficient and functional regulatory system is a core component of a sound financial industry, understanding any potential differences in agency, region, or type of supervision

is crucial for ensuring the best regulatory environment possible. To the best of my knowledge, this is one of the only studies, to date, that incorporates enforcement data from all three U.S. bank regulators and the first to measure varying effects of intervention in distressed banks and why they occur. While understanding how enforcement efficacy across agencies provides insight into how the current regulatory environment functions, exploring why the differences arise is even more important as the findings can help address future regulatory policy decisions.

Although research incorporating enforcement decisions from all agencies is rare, a significant discussion exists that examines how troubled banks behave in light of examiner intervention. The first piece of empirical evidence regarding bank supervision and behavior is the 1991 study by the U.S. Government Accounting Office (GAO), which documents that regardless of regulator, the more forceful the action, the stronger the bank response, across 76 separate actions (GAO, 1991). The findings also show that Capital/Assets improves dramatically when stronger actions are used. In more recent work by Delis et al. (2013), capture the actual impact of these more forceful actions and compare to the effect of weaker action types. Their findings show that for stronger sanctions resulting from core safety and soundness issues, Capital/Assets improves, while the risk of insolvency and return volatility increases. They also find no evidence of significant shifts in bank behavior resulting from less forceful actions.

With the initial work of the U.S. GAO suggesting that regulatory intervention modifies bank behavior, a number of studies quickly emerged testing the broader implications of the sanctions on banks. Using a sample of FDIC and OCC banks in New England from 1989-1993, Peek and Rosengren (1995) document a decline in assets and asset growth rather than an increase in capital. Corroborating these finding using FDIC and Fed sanction data from 1980-1994, FDIC (1997) demonstrate that following the start of an action, asset growth slows significantly. With similar data but from 1980-1996, Curry et al. (1999) suggest that the factors that are most sensitive to enforcement actions are those that bank management has a high degree of control over, such as charge-offs and dividend distributions, finding no evidence of changes in assets growth or external capital infusion. Beyond just those aspects which a bank has a moderate degree of control over, Gilbert and Vaughan (2001) study depositor reactions to regulatory sanctions for Fed banks, finding no change in deposit levels. They suggest that lack of depositor reaction is evidence that deposit insurance

quells serious fears of bank failure and greatly reduces the chances of bank runs.

While the studies of bank behavior around enforcement actions are all diverse in the question being asked and data employed, they universally examine bank behavior around only the beginning of the sanction. As corrective interventions are processes rather than single events, I deviate completely from prior convention by capturing the full enforcement window (before, during, and after). Since my focus is to better understand the differences in effectiveness across agencies regarding bank supervision, and banks are released from the grasp of regulatory sanctions only when the examiners deem the bank "cured", I argue that examining how the cured bank fares following the action is a more appropriate measure of success. As no study, to date, has examined the entire corrective action timeline, I have no prior empirical evidence on which to base my hypotheses. Instead, I appeal to the regulatory agencies, each of which outlines the goals of corrective actions. Given that each agency argues that the sanctions are to be used to correct safety and soundness concerns within distressed banks, I formulate the following hypothesis:

***H1: Banks subject to formal corrective enforcement actions experience a significant increase in stability following the termination of an action.***

This study is not simply focused on the long term effects of sanctions against distressed banks, but also any potential differences that may exist between agencies. As each agency supervises institutions in the same industry, performing largely identical functions, and the agencies have identical powers over the banks under their purviews, a logical conclusion is that there is relatively little dispersion regarding the state of banks coming out of corrective actions. However, recent evidence by Kedia and Rajgopal (2011) suggests that even within the same agency, enforcement action efficacy can differ depending on a number of factors. By studying the SEC's enforcement program, the authors demonstrate that resource constraints play a large roll in supervision, with investigations more likely for those firms that are closer to SEC offices. Given this "constrained cop" theory of supervision, I propose the following hypothesis:

***H2: Regulators with fewer resource constraints are able to more effectively supervise banks.***

Moving beyond the firm-specific sanctions against banks, a number of studies have explored regulatory regimes between countries in order to better understand best practices within broader regulatory design. Barth and Levine (2004) demonstrate empirically that direct government intervention is less effective than

broader guidelines that better align incentives of bank stakeholders. While unable to directly measure the strictness of bank examiners, comparing the proportion of enforcement actions levied against banks to the total number of banks and the average level of stability for all the banks should provide a reasonable proxy for the use of enforcement actions by an agency against affiliate banks. This relative strictness can be used to to examine the following hypothesis:

*H3: The less strict the regulator, the more effective the corrective enforcement action.*

Although these hypotheses are just the tip of the iceberg in understanding the differences between the supervisory process within the U.S. regulatory agencies, they help provide initial insights into an increasingly important issue. Since the domestic bank regulatory system was implemented during a time when the banking landscape was completely different than the present and is rapidly changing, improving our knowledge of the similarities and differences between the agencies and how each behaves is crucial in order to implement proper regulatory systems moving forward.

## **2.3 Data and Empirical Design**

### **2.3 Data**

In order to determine any differences in regulatory effectiveness, I collect all formal corrective actions issued between 2003 and 2013 by the FDIC, Fed, and OCC. Motivated by prior research and documentation of formal enforcement decisions by bank examiners, I choose corrective actions as they are intended to improve bank behavior. Delis et al. (2013) demonstrate that regulatory decisions unrelated to safety and soundness are found not to alter bank behavior, such as civil money penalties and suspension or removal of bank affiliates (either permanent or temporary). I also exclude termination of deposit insurance, as these actions are extremely rare and only used in the most dire of situations, e.g., when a bank's behavior has been so egregious that the only regulatory course of action is essentially a death sentence. The actions used in this study include cease and desist orders, consent orders, formal agreements, prompt corrective actions, and written agreements.

Corrective enforcement announcements are hand collected from the FDIC, Fed, and OCC enforce-

ment action databases.<sup>5</sup> From the formal actions available on the regulatory websites I note the bank, start date, end date (if applicable) and action type. As the enforcement actions list only the bank name, I then match the name to the bank identification number (RSSID) using a combination of a matching algorithm<sup>6</sup> and hand matching. In total, I collect 2,749 corrective action announcements from the primary federal regulatory agencies over the sample period, which was selected due to availability of bank financial data. I remove updates or modifications to formal actions, which are part of the total number of announcements. I also eliminate enforcement actions against banks which are part of a multi-bank holding company in order to reduce any potential confounding effects. The resulting sample is reduced to 1,173 formal corrective actions. Another 51 actions could not be matched to Call Report data and were subsequently dropped. 19 were removed due to missing location information, leaving 1,103 unique corrective actions. A summary of the corrective action data can be found in Figure B.3, while bank summary statistics can be found in Table B.1.

Quarterly bank financial data and regulatory information is collected from the FDIC's Call Report database. This study also utilizes information regarding the financial position, resources, and location of regulatory agencies, which is used to explain any regulatory differences. This data is collected from the annual reports and websites of each agency.

## 2.3 Empirical Framework

To identify variation in regulatory effectiveness between agencies and districts, I use a difference-in-differences approach around the full enforcement action period. This is a significant deviation from the prior research on regulatory enforcement, as no study until now has examined bank behavior before, during, and after intervention. I define the pre-event period as the eight quarters prior to the announcement of the formal action and the post-period as the 8 quarters following the removal of the action. The period in which a bank is subject to regulatory enforcement is removed, as this study is interested in detecting and comparing the

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<sup>5</sup> FDIC: [www5.fdic.gov/edo/DataPresentation.html](http://www5.fdic.gov/edo/DataPresentation.html), Fed: [www.federalreserve.gov/apps/enforcementactions/search.aspx](http://www.federalreserve.gov/apps/enforcementactions/search.aspx), OCC: [apps.occ.gov/EnforcementActions/](http://apps.occ.gov/EnforcementActions/)

<sup>6</sup> Python's Natural Language Toolkit (NLTK) libraries were implemented in order to match the bank name from the enforcement action to the bank identification number in the Call Report database.

long-term efficacy of successful examiner interventions.

As noted in Angrist and Krueger (1999); Lemmon and Roberts (2010), the first step in a sound difference-in-differences model is ensuring that without treatment, there is no significant difference between the treatment and control samples. In examining this "parallel trend" assumption for the entire sample of banks, both treated and untreated, there is clear evidence that the differences between the two samples is severe, suggesting that those banks that are treated were not randomly selected by regulators. While this certainly makes sense, as examiners are only interested in improving the situation of the more distressed banks, there is a clear endogeneity regarding selection of banks by regulators. Compounding the selection issue with the treatment and control groups, there is a potential self-selection problem since banks are able to choose their charter which affects who their primary federal regulator is. As a key question of this study is to examine differences between regulators, this potential self-selection bias could be the reason behind any differences between inter-agency intervention efficacy. I address each of these concerns separately.

Beginning with the potential self-selection bias, I note that the average age of the banks in the sample is well over 30 years old. As the bank charter is established initially when the bank is founded, the majority of the banks in the study chose their charters well before the modern banking era. Before the significant branching deregulation in the 1980s, before the increase in regulatory oversight following the Savings and Loan Crisis of the late 1980s and early 1990s, and well before the tumultuous global financial crisis in the late 2000s. This means that the chartering decision is largely dependent on unobserved choices of management well before this study's sample period. Combined with the average age of the banks is the fact that less than 1.00% of banks historically switch regulators (Rosen, 2005), suggesting that the current charter of a bank is largely a fixed characteristic of the institution. Using firm fixed-effects helps alleviate this unobserved choice, and the potential self-selection bias.

Moving to the parallel trends assumption, comparing the banks subject to intervention to the entire sample of banks results in wildly different samples. Fortunately, examiners have a relatively large amount of latitude regarding their decision to utilize a formal enforcement action. I exploit this leeway in order to satisfy parallel trends. Incorporating a propensity score matched control sample instead of the entire group of banks that avoided regulatory intervention, I am able to construct a sample of similarly distressed banks.

Within this sample of unsafe banks, some are subject to regulatory actions, some are not, and the resulting selection is pseudo-random.

The propensity score matched control group is constructed using the genetic matching method as presented in Diamond and Sekhon (2013). While there is no consensus as to the most appropriate matching method, genetic matching is a method of multivariate matching that automatically updates and improves the covariate balance using an evolutionary search algorithm. This removes the need to manually check the covariate balance. The process is a generalization of the more common Mahalanobis distance method, but as documented in Diamond and Sekhon (2013), can be more appropriate when the treatment selection is relatively severe (very large difference between treatment and broader sample, as in this study). The matching is done using bank size, bank equity, non-performing loans, and change in non-performing loans, with the requirement that the control banks have the same regulators and districts as the treated observations. Table B.2 presents the treat and control sample prior to the match, comparing to the matched sample. This matching method helps ensure that the control group is as close to a counterfactual observation as possible, and satisfying the parallel trends assumption.

Alleviating potential endogeneity allows the use of difference-in-differences estimation in order to detect the changes in regulatory effectiveness. Since the event is identified as the start of a formal corrective action, there is not only a single period in which treatment occurs. Rather, treatment can occur in any number of periods. To control for the varying event periods, I use a two-stage difference-in-differences specification (Bertrand et al., 2004). The method removes the time trends that may result in serial correlation and biased standard errors by averaging variables over the pre- and post-treatment periods. The two stage approach ensures correct standard errors even when the time-series information is removed and the "before" and "after" periods for observations are not identical. The procedure begins by estimating the following panel regression:

$$Y_{it} = \alpha + \beta X_{it} + \gamma Z_t + \phi F_i + \varepsilon \quad (2.1)$$

where  $Y_{it}$  is a measure of bank behavior affected by an enforcement action for bank  $i$  in period  $t$ .  $X_{it}$  is the vector of relevant control variables,  $Z_t$  are time dummies,  $F_i$  is the firm fixed effect. The residuals for

only the treated observations are stored and separated into *before* and *after* the treatment. The second stage regression involves averaging the pre- and post-period residuals and estimating the following regression:

$$Y_i = \alpha + \beta \textit{after} + \varepsilon \quad (2.2)$$

Where  $Y_i$  represents the residuals from the first stage regression for only the treated banks and *after* is a binary variable representing either the pre- or post-treatment period. As the second stage regression includes only the residuals from treated observations, the coefficient on *after* identifies the average treatment effect of intervention relative to the control sample.

Although using difference-in-differences may help detect changes in bank behavior around an enforcement action, without a measure of effectiveness there is no way to compare across and within agencies. I appeal to the regulators in order to determine efficacy. Each regulatory website outlines the use and overall goal of corrective enforcement, with the consensus being that the end goal of intervention is to improve the safety and soundness of distressed banks. From past banking studies, researchers have widely used Z-score as a measure of bank stability. Calculated as the ratio of return on assets to standard deviation of return on assets, Z-score measures the number of standard deviations profitability must fall in order for the institution to become insolvent. Equity capital scaled by assets is used as an alternative measure of stability, as capital to assets essentially captures the cushion a bank has for taking losses. An action is deemed effective if the enforcement action results in the treated bank have a greater Z-score than the control bank, which was left to correct safety and soundness concerns without direct regulatory involvement. In comparing agencies or districts, a more effective action is one that results in a greater improvement to a treated bank's stability over the control sample versus an alternative agency or district.

## 2.4 Results

### 2.4 Regulatory Enforcement Efficacy

Table B.3 presents the average treatment effect of enforcement actions used to correct distressed bank behavior across all agencies. Beginning with the first column of Table B.3, the positive and significant  $\textit{treat} \times \textit{after}$  coefficient suggests that banks subject to regulatory actions experience an average increase in

Z-score following an intervention of 15.78% relative to the matched control group. Moving to the second measure of bank stability, the findings show that Capital/Assets improves by 0.0031 following the completion of a corrective action, significant at the 1% level. As the mean level of Capital/Assets is 0.1069, this improvement following sanctions represents nearly a 3% increase.

Besides confirming the first hypothesis, these results are important as they are the first, that I know of, to show significant improvements to a once distressed bank even after the intervention ends. Although a significant body of literature exists discussing the immediate results of intervention, these corrective sanctions are processes that should be understood from start to end. Not to mention that the global financial crisis beginning in 2008 produced many questions and concerns as to whether regulators were adding value to the financial system through effective oversight. The findings in Table B.3 suggest that overall, compared to similarly distressed banks, regulatory sanctions improve stability within the financial industry. Since the agencies all state that the intent of the interventions is to improve safety and soundness within troubled banks, the findings in this paper support the use of enforcement actions as an effective tool for improving bank stability.

With regulatory sanctions confirmed as being more effective at improving overall stability compared to allowing institutions to correct deficiencies autonomously, I now direct the analysis towards inter-agency differences. While each agency supervises analogous firms and has arguably the same power over their constituents, the bank examination process and the enforcement action decision depend not just on established rules and guidelines, but also on individual judgment and perception of the troubled bank. Coupled with the behavioral aspect of the supervisory process is the fact that each agency has differing resources. These factors could greatly influence the outcome of the enforcement action process. Table B.4 provides the results from analyzing the differences in sanction efficacy between regulators.

Panel A of Table B.4 examines the stability of state-nonmember banks subject to the oversight of the FDIC. The  $\text{treat} \times \text{after}$  coefficient of 0.2205, significant at the 1% level, suggesting that corrective interventions by the FDIC result in a 24.67% increase in Z-score relative to the troubled control banks. Similarly, the second column suggests an increase relative to the average level of Capital/Assets of 4%, with the average treatment effect for the treated banks being 0.0042, significant at the 1% level. While Panel A establishes

that enforcement actions used by the FDIC are effective when compared to similar banks supervised by the FDIC that avoided formal sanctions, Panel B exhibits even greater results for Fed member banks. The  $0.3923 \text{ treat} \times \text{after}$  coefficient shows that Z-score following intervention for the treated banks increases by 48.04% beyond that of the control group. The post-treatment effect for Capital/Assets within Fed banks is similar to those subject to FDIC supervision, with an improvement of just over 4% of mean Capital/Assets following termination of Fed sanctions. While Panel A and Panel B of Table B.4 point towards extremely effective enforcement actions, the results for the nationally chartered banks subject to OCC oversight are less positive. In fact, the  $\text{treat} \times \text{after}$  coefficients for both Z-score and Capital/Assets are insignificant, and even though not statistically different from 0, the Z-score estimate is negative. Although Panel A and B present vastly different estimates of enforcement effectiveness, the overall result was largely the same. The lack of significant findings in Panel C adds even more variation to regulatory effectiveness, suggesting that the success of enforcement actions is either dependent on the regulator or potentially on the characteristics of the banks supervised by each regulator. In order to determine whether the differences are being driven by regulatory or bank characteristics, the rest of this paper is focused on distinguishing between these two alternative effects.

I begin by testing the inter-agency differences between districts. As each supervisor has split the U.S. into individual, relatively autonomous districts that oversee the banks within the region, detecting geographical differences within the same agency would suggest that intervention effectiveness is not solely driven differences in bank characteristics. Table B.5 begins the discussion of these regional differences by estimating the marginal effects of formal sanctions by FDIC districts on Z-score and Capital/Assets. Across the eight FDIC districts, four districts (Dallas, Kansas City, Memphis, San Francisco) demonstrate that enforcement actions result in greater Z-score relative to control banks, with the lowest interaction coefficient being 0.2448, significant at the 5% level. The four other districts (Atlanta, Boston, Chicago, New York) all had  $\text{treat} \times \text{after}$  estimates that were statistically insignificant from 0. The Capital/Assets regression provides nearly the same results as the Z-score, with the main difference being the insignificance of the San Francisco district.

Moving to Table B.6, the differences between the Fed districts are even greater than those of the

FDIC. Cleveland, Chicago, St. Louis, Minneapolis, Kansas City, Dallas, and San Francisco all demonstrate significant improvements in Z-score following the intervention. On the other hand, banks supervised by the Philadelphia branch of the Federal Reserve System experienced negative impacts of corrective sanctions relative to control banks in the region, while Richmond and Atlanta were not noticeably different from 0. Boston and New York districts were not included due to data limitations. Moving to Capital/Assets, only Chicago and Dallas experience positive marginal effects of intervention, while the  $\text{treat} \times \text{after Philadelphia}$  coefficient is negative and significant. The rest are not statistically different from 0.

Finally, Table B.7 provides the estimates for the four OCC regions (Central, Western, Southern, Northeastern), with two being statistically significant. The marginal effect on Z-score of regulatory intervention in the Central OCC region is positive and significant, while the effect for the Southern region is roughly the same magnitude in the opposite direction and significant. These two effects seem to be canceling out in the general OCC specification, resulting in no significance. The other two regions are not significant, as are all the coefficients for the Capital/Assets estimation.

While the coefficients for the marginal effects of region on enforcement action efficacy are difficult to interpret as there is no set baseline with which to compare, the heterogeneity across regions even within the same agency suggests that the findings are not solely driven by bank characteristics. With firm and time fixed effects, the impact of unobserved regional and time differences are absorbed, and variation across districts still exists. These findings then demonstrate that some of the differences in regulatory effectiveness come from the agency differences.

If some of the variation in supervisor enforcement efficacy results from agency differences, using regulator specific data may help uncover the reasons behind alternative levels of effectiveness. Motivated by the findings of Kedia and Rajgopal (2011), I argue that much of the heterogeneity in the impact of corrective sanctions results from regulators being more or less constrained. Before empirically examining the issue, just comparing the number of banks regulated by the Fed versus the FDIC or OCC results in a wide disparity. The Fed is the primary federal regulator for fewer than 900 banks, while number of nationally chartered (therefore, OCC regulated) banks hovers around 2,000. Supervising fewer than half the number of banks relative to the OCC, greater enforcement effectiveness of Fed banks makes sense, as they potentially

have more resources to dedicate to the problem banks.

To empirically examine this constrained cop hypothesis, I construct proxies for degree of constraint. The simplest measure is the regulatory budget per affiliate bank, as this captures the entirety of regulatory resources relative to the number of banks. Examining the marginal effects of greater budgetary resources on corrective action efficacy, Table B.8 presents the results when controlling for agency financial resources. The  $\text{treat} \times \text{after}$  coefficient for Z-score suggests that in the absence of budgetary resources, banks subject to FDIC sanctions would fare far worse than similarly distressed non-sanction banks. As financial resources increase, so does the effectiveness of FDIC interventions. Since Z-score and budget per bank variables have been log-transformed, the interpretation of the positive 0.1827  $\text{treat} \times \text{after} \times \text{budget per bank}$  coefficient is that a 1% increase in budget per bank results in a 0.18% increase in Z-score as a result of intervention. Within the Fed, the results document similar relationships but to a greater degree. That is, in the absence of budgetary resources, efficacy is greatly reduced, while the enforcement action sensitivity to budget per bank changes is greater. The 0.6543  $\text{treat} \times \text{after} \times \text{budget per bank}$  coefficient demonstrates that for each percentage increase in the Fed budget per bank, there is a 0.65% increase in Z-score. The results for the OCC show no significant relationship between treatment and budgetary resources. Table B.8 also examines Capital/Assets, with only Fed member banks being significantly affected by budgetary changes.

While budget relative to the total number of banks allows for insights into the potential financial constraints of the agencies, effective supervision is not just a budgetary issue, but could also depend on the workforce available. Since a large part of the supervisory process involves on site examinations of bank operations, more employees relative to the number of banks could provide a better understanding of why the differences in intervention efficacy arise between agencies. Table B.9 presents the findings regarding the impact of number of employees per affiliate bank on enforcement actions. Overall, the results of workforce constraints on sanctioned bank stability follow the findings of financial constraints, with both FDIC and Fed banks experiencing more effective corrective actions as the number of employees per bank increases.

Historically, financial and, to an even greater degree, labor constraints may have been the most significant bottlenecks with respect to effectively monitoring financial institutions. Modern banking has experienced significant technological developments that resulted in much greater banking efficiency, an, and

how this impacts enforcement efficacy. Using the technological expenditures of each agency scaled by the number of regulated banks, Table B.10 analyzes the use of technology in the supervision process. Overall, the results are surprising and generally un-intuitive. For the FDIC, the  $\text{treat} \times \text{after} \times \text{tech}$  per bank coefficient is negative, suggesting that greater technology investment by the FDIC actually attenuates the gains from intervention. Specifically, that a 1% increase in technological expenditure per bank reduces the effectiveness of intervention by 0.76%, as measured by Z-score. On the other hand, a 1% increase in technological expenditure per bank for those sanctioned by the Fed improves Z-score by 0.70%. As with the prior findings, the OCC's enforcement efficacy remains unchanged by shifts in technology expenditures.

Taking the results from Tables B.8 and B.9, there is evidence of a strong relationship between FDIC and Fed effectiveness of corrective actions and constraints. That is, as the two agencies become less constrained with respect to finances or workforce, the banks they oversee become more stable following intervention. These findings provide support in favor of the constrained cop hypothesis. Surprisingly, there is no significant variation in the OCC with respect to budgetary or labor constraints. While unanticipated, the OCC findings could be due to the fact that the agency supervises nationally chartered banks. Generally, nationally chartered banks are larger than state-chartered institutions and there is a likely a positive correlation between size and complexity. The lack of significant response could be the result of the average complexity of OCC institutions.

Turning now to the idea that the degree of strictness of regulatory regimes plays an important role in the stability and behavior of the banking industry, I measure the relative strictness of each agency across time and examine how this austerity impacts corrective action efficacy. In calculating relative strictness I compare the number of distressed banks under a particular regulator's authority to the number of banks subject to formal actions in each time period. Distressed banks are identified as those banks which are one standard deviation above the mean level of non-performing loans to assets. The larger the ratio, the more enforcement decisions are being used against troubled banks. Simply comparing the ratios for each regulator, the average enforcement ratio for the FDIC is 0.63, for the Fed is 0.65, and for the OCC is 0.86. Given the main findings of differences in intervention efficacy, there is already evidence in favor of the third hypothesis, that less strict supervision results in greater stability.

More formally, Table B.11 shows the effect of regulatory severity on how banks fare throughout the intervention process. For the FDIC and Fed, who both have similar levels of strictness, periods in which the agencies were harsher experience declines in Z-score following intervention, as indicated by the negative coefficient on  $\text{treat} \times \text{after} \times \text{enforcement}$  ratio. A similar result is also found for Capital/Assets within the Fed. The OCC experiences no significant results after controlling for the enforcement ratio with respect to Z-score, but experiences gains to Capital/Assets as strictness increases. This result is at odds with the findings of the Fed and the more general average degree of strictness, but could be due to differences in the characteristics of the OCC banks relative to the institutions affiliated with other agencies.

Finally, I estimate the impact of distance from the regulatory field office. Given the findings in Kedia and Rajgopal (2011) and the evidence presented in this paper in favor of the constrained cop hypothesis, I expect distance to influence the effectiveness of regulatory intervention. The findings in Table B.12 actually demonstrate that the distance to the supervisor field office has no impact on sanction efficacy. This result is surprising since there is evidence favoring the idea that banks gain information from regulatory proximity. Given that the examiner's main concern is bank stability and risk, perhaps the marginal gain from being near a bank is negligible, whereas a bank manager is focused not just on pleasing regulators but also running a successful business. If the information gained from the regulatory proximity is not incredibly critical, thus lowering point at which marginal cost equals marginal benefit, banks benefiting from proximity to the supervisor could make sense. The simple fact of the matter may be that knowledge of bank distress and behavior is the core function of the regulators, so the point at which marginal benefit equals marginal cost is extremely low. While I have no empirical evidence in support of this claim, the findings I have shown suggest no relationship between regulatory efficacy and location.

## **2.4 Survival Analysis of Regulatory Diligence**

I now examine the differences in vigilance between the regulators, where vigilance is measured by how quickly distressed banks are placed under corrective actions. Using a Cox proportional hazards (CPH) model I estimate the likelihood of a distressed bank being placed under corrective sanctions. In estimating the CPH for being placed under a corrective action, I identify distressed banks by first estimating the mean

and standard deviation of non-performing assets/capital for each time period. An institution is considered distressed if the level of non-performing assets/capital is greater than one standard deviation above the mean. A bank is either put under an enforcement action by a regulator or corrects asset quality deficiencies and is removed from the sample.

Beginning with Figure B.4, which shows the Kaplan-Meier survival functions of each regulatory agency, there is clear indication of vastly different degrees of vigilance. The OCC acts much earlier than the FDIC or Fed. Given the evidence that the Fed and FDIC are more effective at correcting distressed bank stability through enforcement actions, Figure B.4 suggests that the timing of enforcement relative to bank characteristics could be a contributing factor to the efficacy variation. Using CPH, I examine the specific bank characteristics that result in enforcement action decisions. Any differences that exist between regulators in the aspects of bank behavior that trigger enforcement decisions could potentially help explain why efficacy differences persist.

Table B.13 present the findings of the CPH estimation prior to the corrective action announcement. As the hazard rate measures how long a distressed bank avoids corrective sanctions, a reduction in the hazard rate indicates longer time before experiencing enforcement. The first column of panel A indicates that bank size slightly reduces the chances of enforcement, as indicated by the 1.17% decline in the hazard rate for a one standard deviation increase in log size (total assets). Greater bank safety, as measured by capital/assets, significantly reduces the chances of sanctions, with a one standard deviation improvement in capital/assets resulting in an 8.9% reduction in the hazard rate, while a one standard deviation increase in non-performing assets/capital results in a 15.12% increase the chances of enforcement. Surprisingly, higher level of loan/assets results in lower chances of enforcement, with a one standard deviation increase in the proxy for liquidity resulting in a 12.22% reduction in the odds of enforcement. Finally, the distance coefficient demonstrates that the further from the regulator a bank is, the lower the chances of enforcement, with a 9.05% decline in the hazard rate given a one standard deviation increase in distance..

As there is evidence that the Fed and FDIC are effective at enforcement relative to the OCC, dividing the hazard estimates between agencies reveals which variables seem to impact the sanction decision most. The Fed enforcement decision is largely influenced by capital/assets, whereas they seemingly overlook the

impact of bad assets relative to capital. Additionally, lower levels of liquidity significantly increase the chances of corrective actions. Similarly, the FDIC's decision is largely impacted by changes in liquidity, while non-performing assets/capital is a much greater factor for FDIC decision relative to the Fed. The key difference between the two effective agencies and the OCC seems to be the level of liquidity, with lower chances of sanctions given higher proportion of loans/assets. While not suggesting that the OCC should focus more on liquidity measures, the heterogeneity in the survival analysis results suggest that the method may be a useful tool in pinpointing where and why the regulatory effectiveness differences exist.

## **2.5 Conclusion**

With the continually changing bank regulatory environment within the U.S., the importance of the industry to the overall economy, and the relatively recent global banking crisis, better understanding of the regulatory process is essential to developing a more stable banking sector. Since one of the key mechanisms through which the regulators maintain industry stability is formal enforcement action, determining whether the sanctions are effective at improving bank safety is clearly an important question from a regulatory design perspective. With three unique regulatory agencies in the U.S. and the close of the fourth following the banking crisis, understanding whether the actions work overall is important, but developing a clear sense of any differences that may exist between the agencies is necessary in order to ensure a stable banking industry.

In addressing the question of corrective sanction efficacy, this paper tests whether banks subject to enforcement become more stable following completion of the action relative to a matched sample of similarly distressed banks that avoided actions. The findings show that some agencies are far more effective than others at improving the safety of troubled banks comparably troubled banks. Specifically, Fed member banks subject to sanctions experience a much higher Z-score following intervention compared to similar Fed member banks that were not under sanctions. Similar results appear for FDIC banks, although to a lesser extent, while no significant difference exists between interventions in nationally chartered OCC banks and the control group.

To understand why differences exist between agencies that perform the same functions related to firms within the same industry I incorporate agency characteristics into the analysis. Testing whether the

degree of financial or labor constrains influences regulatory efficacy I find that for the FDIC and Fed, more resources result in greater effectiveness, although there exist no such findings for the OCC. Moving to the relative strictness of the agency, I find that the less strict an agency is, the greater the gain from the sanction. Finally, to test whether distance plays a role in the effectiveness of bank examiners, finding no relationship between sanction efficacy and distance to regulatory field office.

Although the differences in regulator characteristics did little to help understand why effectiveness differs across regulators, using the Cox proportional hazards model I highlight some key differences between the relatively effective agencies and the OCC. While the hazard estimates suggest that there are significant differences in the processes used by the regulators, the findings do little other than provide more questions. That is not to say comparing the hazard rates across agencies is incorrect, rather that more research is needed in order to identify the principal catalysts behind the differences.

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## **Appendix A**

### **Chapter 1 Graphs and Tables**

Figure A.1: **Price-Cost Elasticity Around Local Regulatory Intervention**

This graph plots the fitted values of the H-Statistic in treated and control counties around regulatory intervention. The H-Statistic measures the price-cost elasticity with decreases in H-Statistic indicate more inelastic price-cost relationship. The treated counties are identified as those which have one bank subject to an enforcement action and period 0 indicates the announcement of the regulatory intervention. Thus  $t=0$  for the control counties simply indicates the time period the treated county experienced intervention. Sample period is from 2003-2013, and data to calculate the H-Statistic comes the FDIC Call Report database.

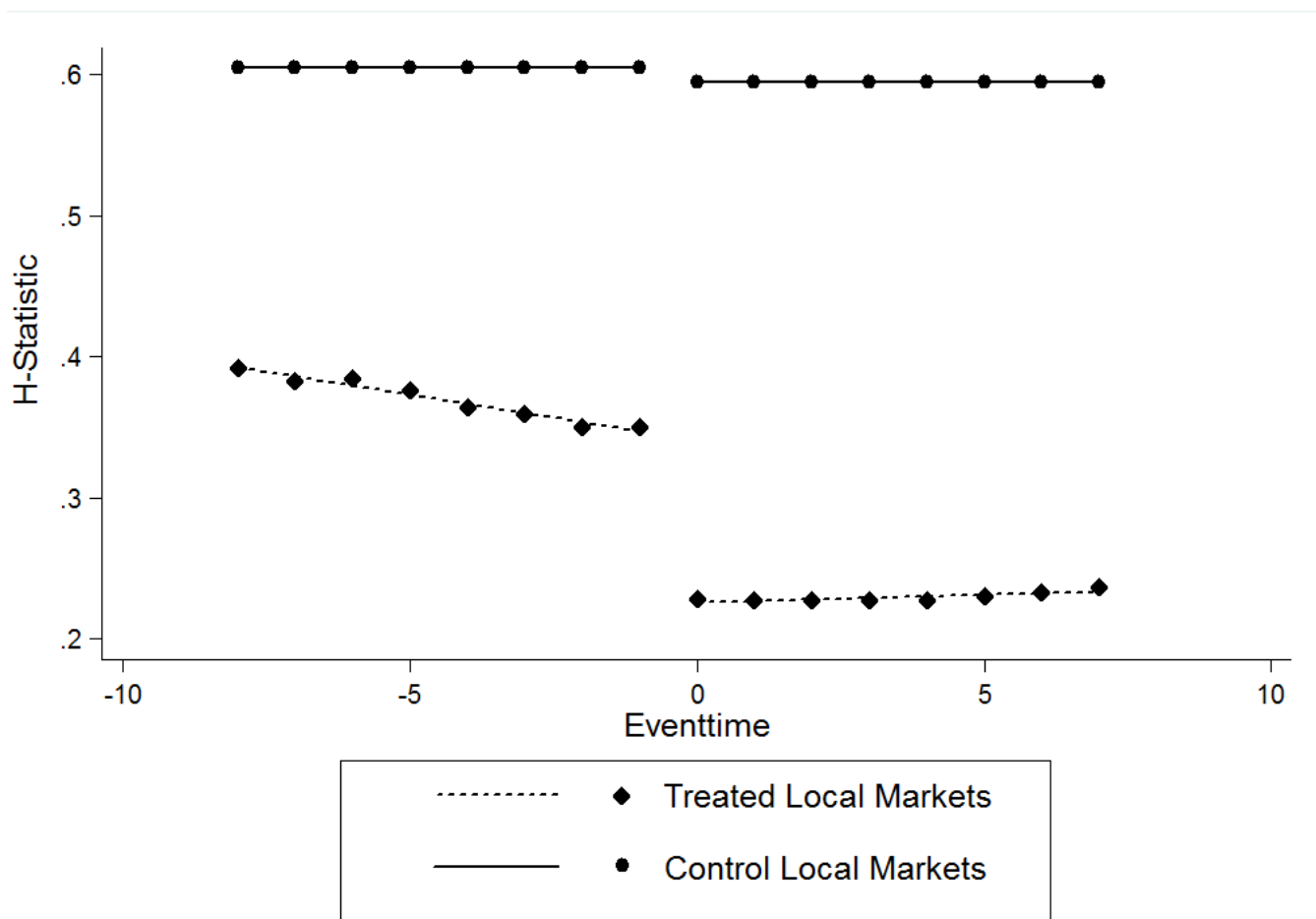


Table A.1: Summary of Strategic Response to Distressed Rival

Paper	Signal of Distress	Industries	Sample	Main Findings	Additional Findings
Phillips (1995)	Leveraged recapitalization	(1)Fiberglass insulation, (2)tractor trailer, (3)polyethylene, and (4)gypsum	(1) 75 firms, (2) 77 firms, (3) 97 firms, and (4) 100 firms. Monthly data from 1980 to 1990.	Industries (1), (2), and (3) demonstrate negative relationship between output and leverage. Industry (4) shows positive correlation between output and leverage.	Price is positively associated with the average debt ratio in industries (1), (2), and (3), while price negatively associated with leverage in industry (4). Firms in industries (1), (2), and (3) have higher leverage than firms in industry (4).
Chevalier (1995)	Leveraged buyout	Supermarkets	79 local markets experiencing a leverage buyout between 1981 and 1990.	Following a leveraged buyout, financially constrained local rival supermarkets increase prices, indicating a decline in competition. Unconstrained rivals reduce prices and increase competition.	The predatory response by unconstrained rivals reduces the leveraged buyout supermarket's market share and increases the probability of exit from the market.
Borenstein and Rose (1995)	Chapter 11 bankruptcy	Airlines	7 airline bankruptcies from 1987 to 1993.	Following a bankruptcy, rival airlines do not change prices significantly, even after controlling for the financial strength of the rival firm. There is no evidence of predatory pricing by competing airlines.	Airlines filing for bankruptcy do reduce prices slightly prior to filing, although this does not increase their market share.
This paper	Bank enforcement actions	Banks	222 local markets from 2003 to 2013.	Significant increase in local competition following an enforcement action. Financially constrained local market increase competition less than unconstrained local markets.	Evidence that greater competition results in more local bank stability. Results show no significant change in pricing around enforcement action.

Table A.2: **Types of Enforcement Action Available to Bank Regulators**

Informal actions are non-legally binding agreements between banks and supervisors that are not disclosed to the public. While not an admission of guilt, formal actions are legally binding agreements between banks and supervisors that disclosed to the public. The corrective actions are in bold and this study specifically focuses on corrective actions, as prior studies have linked these actions to changes in bank behavior.

Section	Action Type	Formal/Informal	Description
-	Supervisory Letters	Informal	Letter to a bank addressing very minor issues within the organization or to request periodic updates addressing specific aspects of a bank's operations. Generally sent directly to bank managers and does not need approval from board of directors.
-	Bank Board Resolution	Informal	Declaration by a bank's board of directors outlining a plans to deal with the bank's safety and soundness issues, setting forth plans and time horizons to carry out reforms.
-	Memorandum of Understanding (MOU)	Informal	Agreement between regulators and a bank (signed by the bank's board of directors) outlining a reform plan with specific deadlines, with the caveat being that the agreement is not enforceable in court.
8(i)(2)	Civil Money Penalties	Formal	Assessed to sanction an institution or institution affiliated party according to the degree of culpability and severity of the violation, breach, and/or practice and also deter future occurrences.
8(g)	Suspension Order	Formal	Issued to institution affiliated parties who are charged with felonies involving dishonesty or a breach of trust pending the disposition of the criminal charges.
8(e)(3)	Temporary Suspension Order	Formal	Temporary removal of institution affiliated party pending a hearing for Order of Removal (Section 8(e)(3)) if individual's continued participation poses an immediate threat to the institution or the interest's of the institution's depositors.
8(e)(1)	Removal and Prohibition Order	Formal	Issue to remove any institution affiliated party (director, officer, employee, etc.). May be for specific activities or industry wide.
-	<b>Prompt Corrective Action (PCA)</b>	Formal	Issued to address concerns regarding a bank's capital adequacy. Used to resolve the problems of insured depository institutions so as to minimize the potential long-term loss to the Deposit Insurance Fund.
8(c)	<b>Temporary Cease and Desist Order</b>	Formal	Issued in the most severe situations to halt particularly egregious practices pending a formal hearing on permanent cease and desist orders.
8(b)	<b>Cease and Desist Order</b>	Formal	Issued to halt violations of law as well as to require affirmative action to correct any condition resulting from such violations.
8(a&t)	Temporary Suspension of Deposit Insurance	Formal	Removal of FDIC deposits insurance. Rarely used and generally a death sentence for a bank.
8(a)	Termination of Insurance	Formal	Removal of FDIC deposits insurance. Rarely used and generally a death sentence for a bank.

Table A.3: **Summary Statistics of Sample Banks**

The summary statistics are presented for all 8,490 banks between 2003 and 2013. All data comes from FDIC Call Report database and Summary of Deposits database. Figures below have been winsorized at the 1% level.

<b>Panel A: Full Sample</b>					
	Mean	Median	Std Dev	Min	Max
Z-score	2.8473	2.3681	2.0470	1.2071	18.9877
ROA	0.0021	0.0024	0.0033	-0.0174	0.0145
ROE	0.0206	0.0229	0.0284	-0.1941	0.0860
Assets	324.8942	103.2360	1137.3060	8.5057	12673.4000
Capital/Assets	0.1200	0.0995	0.0877	0.0497	0.8114
Funding Costs	0.0072	0.0070	0.0025	0.0003	0.0135
Labor Costs	14.4059	13.3333	4.8415	6.7143	38.1448
Physical Capital Costs	0.1080	0.0603	0.1957	0.0083	1.9275
<b>Panel B: Treatment Counties</b>					
	Mean	Median	Std Dev	Min	Max
Z-score	2.8471	2.3680	2.0451	1.2071	18.9877
ROA	0.0017	0.0020	0.0035	-0.0174	0.0145
ROE	0.0155	0.0188	0.0334	-0.1941	0.0860
Assets	500.1090	128.2150	1585.3820	8.5057	12673.4000
Capital/Assets	0.1200	0.0995	0.0876	0.0497	0.8114
Funding Costs	0.0045	0.0041	0.0026	0.0003	0.0135
Labor Costs	15.1341	14.2609	4.9190	6.7143	38.1448
Physical Capital Costs	0.1066	0.0588	0.2014	0.0083	1.9278

Table A.4: **Competition Summary Statistics**

Summary statistics of the measures of competition used in the study at the country level. Detailed estimation methods can be found in the Section 4.2 of the text. All data for estimation of competition variables comes from FDIC Call Report database and Summary of Deposits database. All data is winsorized at the 1% level.

	<b>Full Sample</b>				
	Mean	Median	Std Dev	Min	Max
H-Statistic	0.5062	0.4715	0.6153	-1.3358	2.3766
$CE_{min}$	7.6075	7.5582	1.2023	4.5694	10.8190
Deposit HHI	4029	4127	1258	1204	7494

Table A.5: Average Competition by Treated and Control, Before and After Treatment

Summary statistics of the measures of competition used in the study at the country level. Detailed estimation methods can be found in the Section 4.2 of the text. All data for estimation of competition variables comes from FDIC Call Report database and Summary of Deposits database. All data is winsorized at the 1% level.

		Average H-Statistic						
Full Sample		2003-2007		2008-2010		2011-2013		
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Control	0.6035	0.5939	0.6151	0.6252	0.4762	0.3596	0.4371	0.3938
Treatment	0.4861	0.2338	0.5296	0.4551	0.5252	.3149	.3508	0.2967
Total		2003-2007		2008-2010		2011-2013		
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Control	0.6212	0.6312	0.5780	0.5970	0.6330	0.6527	0.6173	0.6272
Treatment	0.5689	0.6193	0.5987	0.6048	0.5498	0.6339	0.5558	0.6026
		Average Deposit HHI						
Full Sample		2003-2007		2008-2010		2011-2013		
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Control	4312	4431	4262	4265	4285	4412	4350	4430
Treatment	4268	4363	4195	4038	4176	4337	4143	4188

Table A.6: **Competitive Reaction to Local Enforcement Action**

Difference in differences estimates (two years before and after) of measures of local competition before and after an enforcement action is levied against a rival bank. The treatment group consists of all banks headquartered within those counties the enforcement action bank has branches. The control group consists of those individual counties within the same state that have similar size and number of banks. The *after* variable is an indicator equal to 0 if before intervention and 1 after. The difference in differences estimates are calculated using the 2-stage methodology for rolling treatments suggested by Bertrand et al. (2004). The dependent variable is regressed on a full panel with time and firm fixed effects and relevant covariates in the first stage. The residuals for the *treat* group are the regressed on the *after* dummy variable. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels.

	H-Statistic	H-Statistic	$CE_{min}$	$CE_{min}$	Deposit HHI	Deposit HHI
<i>treat</i> × <i>after</i>	-0.1902*** (0.041)	-0.2044*** (0.055)	0.0808*** (0.026)	0.0507* (0.031)	-8.7927 (29.229)	10.2030 (40.245)
credit unions		0.0122 (0.012)		0.0098 (0.006)		29.0896*** (9.751)
Region Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Treated Counties	402	402	402	402	402	402
$R^2$	0.5520	0.5508	0.5983	0.6403	0.8569	0.8465

Table A.7: Competitive Reaction Across Different Time Periods

Difference in differences estimates (two years before and after) of measures of local competition before and after an enforcement action is levied against a rival bank. The results are divided between the pre-crisis period (2003-2007), the crisis period (2007-2010), and the post-crisis period (2011-2013). The treatment group consists of all banks in the same county as enforcement action bank, control group is banks in all other counties without enforcement actions in the state during the same time period. The *after* variable is an indicator equal to 0 if before intervention and 1 after. The difference in differences estimates are calculated using the 2-stage methodology for rolling treatments suggested by Bertrand et al. (2004). The dependent variable is regressed on a full panel with time and firm fixed effects and relevant covariates in the first stage. The residuals for the *treat* group are the regressed on the *after* dummy variable. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels.

Panel A: Competitive Response Before Financial Crisis (2003-2007)						
	H-Statistic	H-Statistic	CE <sub>min</sub>	CE <sub>min</sub>	Deposit HHI	Deposit HHI
treat × after	0.1001 (0.066)	0.0712 (0.095)	0.1070*** (0.031)	0.1057*** (0.037)	-15.2280 (33.593)	10.8966 (47.069)
credit unions		0.0232 (0.020)		-0.0350*** (0.013)		46.2837*** (14.542)
Region Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Treated Counties	142	142	142	142	142	142
R <sup>2</sup>	0.6186	0.6116	0.7065	0.7467	0.9312	0.9338

**Panel B: Competitive Response During Financial Crisis (2008-2010)**

	H-Statistic	H-Statistic	$CE_{min}$	$CE_{min}$	Deposit HHI	Deposit HHI
treat×after	-0.1955** (0.086)	-0.1967* (0.108)	-0.0065 (0.059)	-0.0262 (0.078)	31.0468 (50.796)	61.4641 (68.356)
credit unions		0.0547 (0.035)		-0.0116 (0.013)		16.5193 (26.048)
Region Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Treated Counties	138	138	138	138	138	138
$R^2$	0.6402	0.6339	0.7137	0.7026	0.9020	0.8835

<b>Panel C: Competitive Response After Financial Crisis (2011-2013)</b>						
	H-Statistic	H-Statistic	CE <sub>min</sub>	CE <sub>min</sub>	Deposit HHI	Deposit HHI
treat×after	-0.2002*** (0.059)	-0.2039*** (0.076)	0.0018 (0.035)	-0.0389 (0.033)	-40.3399 (39.474)	-38.5629 (53.298)
credit unions		-0.0492** (0.020)		0.0019 (0.008)		-45.1313*** (14.871)
Region Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Treated Counties	122	122	122	122	122	122
R <sup>2</sup>	0.6238	0.6258	0.7358	0.7933	0.8930	0.8881

Table A.8: Local Financial Constraint and Subsequent Competitive Reaction

Difference in differences estimates (two years before and after) of measures of local competition before and after an enforcement action is levied against a rival bank. Panel A analyzes the most financially constrained treatment counties measured before the enforcement action announcement, while Panel B analyzes the least financially constrained treatment counties. The treatment group consists of all banks in the same county as enforcement action bank, control group is banks in all other counties without enforcement actions in the state during the same time period. The *after* variable is an indicator equal to 0 if before intervention and 1 after. The difference in differences estimates are calculated using the 2-stage methodology for rolling treatments suggested by Bertrand et al. (2004). The dependent variable is regressed on a full panel with time and firm fixed effects and relevant covariates in the first stage. The residuals for the *treat* group are the regressed on the *after* dummy variable. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels.

<b>Panel A: High Financial Constraint Local Markets</b>			
	H-Statistic	$CE_{min}$	Deposit HHI
treat $\times$ after	-0.2167*** (0.073)	0.1011* (0.051)	35.6065 (58.655)
credit unions	0.0059 (0.013)	-0.0013 (0.005)	29.7785*** (9.813)
Region Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Treated Counties	201	201	201
$R^2$	0.5539	0.6337	0.6959
<b>Panel B: Low Financial Constraint Local Markets</b>			
	H-Statistic	$CE_{min}$	Deposit HHI
treat $\times$ after	-0.2092** (0.083)	0.0546 (0.042)	8.1015 (53.257)
credit unions	0.0118 (0.012)	-0.0001 (0.006)	29.2313*** (9.673)
Region Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Treated Counties	201	201	201
$R^2$	0.5533	0.6125	0.8500

Table A.9: **Competitive Reaction to Local Enforcement Action: Local Housing Market Strength**

Difference in differences estimates (two years before and after) of measures of local competition before and after an enforcement action is levied against a rival bank and interacting the strength of local banking market with the post-treatment period. Housing market vibrancy is used to proxy for the strength of the local banking market. Vibrancy of housing markets calculated using the Zillow Home Value Index. The housing market measure is normalized between 0 and 1. The *after* variable is an indicator equal to 0 if before intervention and 1 after. The difference in differences estimates are calculated using the 2-stage methodology for rolling treatments suggested by Bertrand et al. (2004). The dependent variable is regressed on a full panel with time and firm fixed effects and relevant covariates in the first stage. The residuals for the *treat* group are the regressed on the *after* dummy variable. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels.

<b>Panel A: H-Statistic</b>			
<i>treat</i> × <i>after</i>	-0.2268* (0.117)	-0.1862*** (0.070)	-0.1866*** (0.092)
<i>county</i> × <i>treat</i> × <i>after</i>	-0.0956 (0.086)		
<i>state</i> × <i>treat</i> × <i>after</i>		-0.1040* (0.058)	
U.S. × <i>treat</i> × <i>after</i>			-0.0256 (0.045)
Region Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Treated Counties	128	225	402
$R^2$	0.6201	0.6231	0.6199

<b>Panel B: Competition Efficiency</b>			
	(1)	(2)	(3)
treat×after	0.0695*** (0.022)	0.0822*** (0.014)	0.1167*** (0.018)
county×treat×after	0.0354* (0.021)		
state×treat×after		0.0062 (0.011)	
U.S.×treat×after			0.0311*** (0.008)
Region Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
Controls	Yes	Yes	Yes
$R^2$	128 0.6879	225 0.6991	402 0.6870

<b>Panel C: Deposit HHI</b>			
	(1)	(2)	(3)
treat × after	185.2572*** (59.464)	118.4509*** (35.071)	177.3015*** (37.730)
county × treat × after	5.4428 (59.537)		
state × treat × after		33.5622 (30.545)	
U.S. × treat × after			57.4274*** (18.628)
Region Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Treated Counties	128	138	138
$R^2$	0.8703	0.8902	0.8677

Table A.10: **Competitive Reaction to Local Enforcement Action Controlling for Sanctioned Bank**

Difference in differences estimates of measures of local competition before and after an enforcement action is levied against a rival bank, controlling for the characteristics of the bank subject to sanctions. The treatment group consists of all banks headquartered within those counties the enforcement action bank has branches. The control group consists of those individual counties within the same state that have similar size and number of banks. The *after* variable is an indicator equal to 0 if before intervention and 1 after. The difference in differences estimates are calculated using the 2-stage methodology for rolling treatments suggested by Bertrand et al. (2004). The dependent variable is regressed on a full panel with time and firm fixed effects and relevant covariates in the first stage. The residuals for the *treat* group are the regressed on the *after* dummy variable. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels.

	H-Statistic	CE <sub>min</sub>	Deposit HHI	H-Statistic	CE <sub>min</sub>	Deposit HHI
treat × after	-0.7149* (0.365)	-0.1909 (0.178)	298.1984 (304.907)	-0.6819** (0.317)	-0.1528 (0.146)	199.4313 (296.273)
treat × after × size	0.0435 (0.032)	0.0219 (0.015)	-25.4207 (25.917)	0.0422 (0.028)	0.0186 (0.012)	-17.0068 (25.701)
size	-0.0120 (0.012)	-0.0282*** (0.008)	-36.8522*** (14.548)			
deposits				-0.0263*** (0.010)	-0.0247*** (0.008)	-28.2817** (12.439)
Region Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Treated Counties	402	402	402	402	402	402
R <sup>2</sup>	0.5511	0.6187	0.8468	0.6403	0.8569	0.8465

Table A.11: **Bank Stability Shifts Following Change in Competition**

Difference in differences estimates of measures of bank stability before and after an enforcement action is levied against a rival bank. The treatment group consists of all banks in the same county as enforcement action bank, control group is banks in all other counties without enforcement actions in the state during the same time period. The *after* variable is an indicator equal to 0 if before intervention and 1 after. The difference in differences estimates are calculated using the 2-stage methodology for rolling treatments suggested by Bertrand et al. (2004). The dependent variable is regressed on a full panel with time and firm fixed effects and relevant covariates in the first stage. The residuals for the *treat* group are the regressed on the *after* dummy variable. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels.

	Z-score	Bank Equity
Post Treatment	0.0050* (0.004)	0.0009* (0.001)
Time Fixed Effects	Yes	Yes
Region Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Controls	Yes	Yes
Treated Counties	330	330
$R^2$	0.9766	0.8651

Table A.12: **Bank Performance Shifts Following Change in Competition**

Difference in differences estimates of rival bank performance before and after an enforcement action is levied against a rival bank. The treatment group consists of all banks headquartered within those counties the enforcement action bank has branches. The control group consists of those individual counties within the same state that have similar size and number of banks. The *after* variable is an indicator equal to 0 if before intervention and 1 after. The difference in differences estimates are calculated using the 2-stage methodology for rolling treatments suggested by Bertrand et al. (2004). The dependent variable is regressed on a full panel with time and firm fixed effects and relevant covariates in the first stage. The residuals for the *treat* group are the regressed on the *after* dummy variable. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels.

	ROA	ROE
<i>treat</i> × <i>after</i>	0.0000 (0.000)	0.0002 (0.001)
Time Fixed Effects	Yes	Yes
Region Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Controls	Yes	Yes
Treated Counties	407	407
$R^2$	0.5370	0.5411

## Appendix A.1

Variables are created using financial information from the quarterly Call Report data, unless otherwise noted. Variable codes provide the location of each variable in the Call Report filings.

Variable	Description
<i>Z - Score</i>	$(AverageROA_{t-4,t} + (Capital - to - Assets))/(\sigma(ROA)_{t-4,t})$ ; Measure of the number of standard deviations by which bank returns must fall to wipe out bank equity (Boyd and Runkle, 1993)
<i>ROA</i>	$EBITDA/TotalAssets$ ; Ratio of income before interest, taxes, depreciation, and amortization (RIAD4301) to total assets (RCON2170).
<i>ROE</i>	$EBITDA/TotalEquity$ ; Ratio of income before interest, taxes, depreciation, and amortization (RIAD4301) to bank equity (RCON3210).
<i>Loan Yield</i>	$InterestIncome/TotalLoans$ ; Ratio of income from lending (RIAD4010) to the amount of total loans (RCON2122).
<i>TR</i>	$(InterestIncome + Non - interestIncome)$ ; Total revenue is the sum of interest income from fees and lending (RIAD4107) and any income from other activities (RIAD4079).
<i>Q</i>	$TotalAssets$ ; Bank output as measured by total assets (RCON2170).
<i>FC</i>	$InterestExpense/Liabilities$ ; Funding cost is the ratio of expenses related to lending (RIAD4073) to the amount of total liabilities (RCON2948).
<i>CL</i>	$EmployeeSalaries/Employees$ ; Labor cost is the ratio of total full time employee salaries (RIAD4135) to the number of full time employees (from Summary of Deposits).
<i>CFA</i>	$FixedAssetExpense/FixedAssets$ ; Fixed asset cost is the ratio of fixed assets expense (or premises expense, RIAD4217) to total fixed assets (RCON2145).
<i>LNS/TA</i>	$Loans/TotalAssets$ ; Ratio of total loans (RCON2122) to total assets (RCON2170).
<i>NEA/TA</i>	$Non - earningAssets/TotalAssets$ ; Ratio of non-earning assets (RCON2150 + sum Column C from Schedule RC-N) to total assets (RCON2170).
<i>DEP/TL</i>	$Deposits/TotalLiabilities$ ; Ratio of deposits (RCON2200) to total liabilities (RCON2948).
<i>CAP/TA</i>	$EquityCapital/TotalAssets$ ; Leverage ratio, measuring bank equity capital (RCON3210) to total assets (RCON2170).
<i>OI/II</i>	$OtherIncome/InterestIncome$ ; Ratio of income from non-core activities (RIADB497) to interest income (RIAD4107).
<i>RevRatio</i>	$TotalRevenues/OperatingCosts$ ; Revenue ratio is the total revenues (RIAD4107 + RIAD4079) to operating costs (RIAD4073 + RIAD4093).
<i>DEP/BR</i>	$Deposits/TotalBranches$ ; Total bank deposits (RCON2200) divided by the number of bank branches (from Summary of Deposits).
<i>L/BR</i>	$EmployeeSalaries/TotalBranches$ ; Full time employee salaries (RIAD4135) divided by the number of bank branches (from Summary of Deposits).
<i>LLR</i>	$(TotalLoans - ProvisionforLoanandLeaseLoss)/TotalLoans$ ; Loan loss ratio measures the ratio of total loans (RCON2122) net of the provision for loan and lease losses (RIAD4230) to total loans (RCON2122).
<i>RATE</i>	Interest rate for 3-month Treasury bills.

## Appendix A.2

**Table A.13: Competitive Reaction to Enforcement Action within MSA**

Difference in differences estimates of measures of local competition before and after an enforcement action is levied against a rival bank. The treatment group consists of all banks in the same MSA as the enforcement action bank. The control groups are the banks within the five nearest MSA regions (with a maximum distance of 500 miles) without enforcement actions during the same time period. The *after* variable is an indicator equal to 0 if before intervention and 1 after. The difference in differences estimates are calculated using the 2-stage methodology for rolling treatments suggested by Bertrand et al. (2004). The dependent variable is regressed on a full panel with time and firm fixed effects and relevant covariates in the first stage. The residuals for the *treat* group are the regressed on the *after* dummy variable. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels.

	H-Statistic	$CE_{min}$	Deposit HHI
treat $\times$ after	-0.2661 *** (0.074)	0.0364 (0.092)	-59.6841 (67.481)
Region Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Treated Counties	284	284	284
$R^2$	0.5231	0.5751	0.8115

Table A.14: **Competitive Reaction to Enforcement Action within Branching Counties**

Difference in differences estimates of measures of local competition before and after an enforcement action is levied against a rival bank. The treatment group consists of all banks headquartered within those counties the enforcement action bank has branches. The control group consists of those individual counties within the same state that are similar to the characteristics of the constructed treatment local market, while also ensuring that there is no enforcement actions over the same time period. The *after* variable is an indicator equal to 0 if before intervention and 1 after. The difference in differences estimates are calculated using the 2-stage methodology for rolling treatments suggested by Bertrand et al. (2004). The dependent variable is regressed on a full panel with time and firm fixed effects and relevant covariates in the first stage. The residuals for the *treat* group are the regressed on the *after* dummy variable. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels.

	H-Statistic	CE <sub>min</sub>	Deposit HHI
<i>treat</i> × <i>after</i>	0.0709 (0.110)	0.0425* (0.022)	47.4073 (52.203)
Region Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Treated Counties	184	184	184
R <sup>2</sup>	0.6109	0.6350	0.9260

## **Appendix B**

### **Chapter 2 Graphs and Tables**

Figure B.1: **Stability of Distressed Banks Throughout Enforcement Action Period**

This figure plots banks stability, as measured by Z-score, for treated and control banks. Plotted in event time, the "Pre-EA" section represents the period prior to regulatory intervention. Clearly both sets of banks are experiencing a deterioration in stability, but only the treated banks actually come under formal corrective actions. The "During-EA" is an average of the enforcement action time period for all the treated banks. As enforcement actions last until the regulator deems the bank stable again, I calculate the average length of an enforcement action and then find the mean level of stability for the banks during that period. As this study compares only the before and after action time periods, the enforcement action period is included largely for continuity rather than interpretation. The "Post-EA" portion is the period following the removal of formal sanctions against a distressed bank.

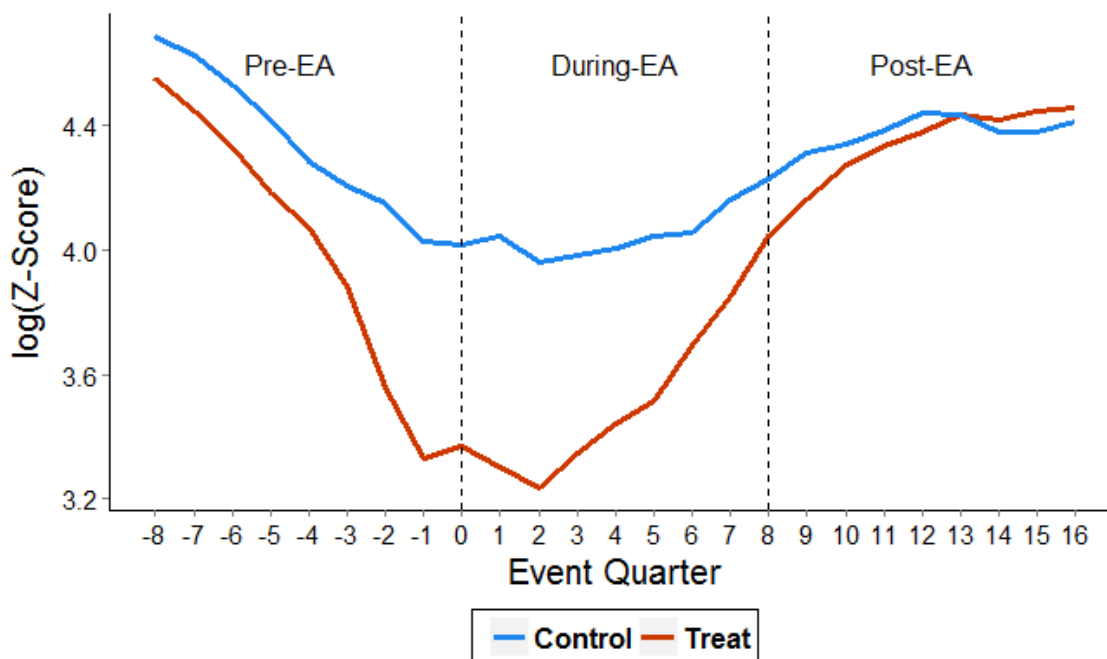
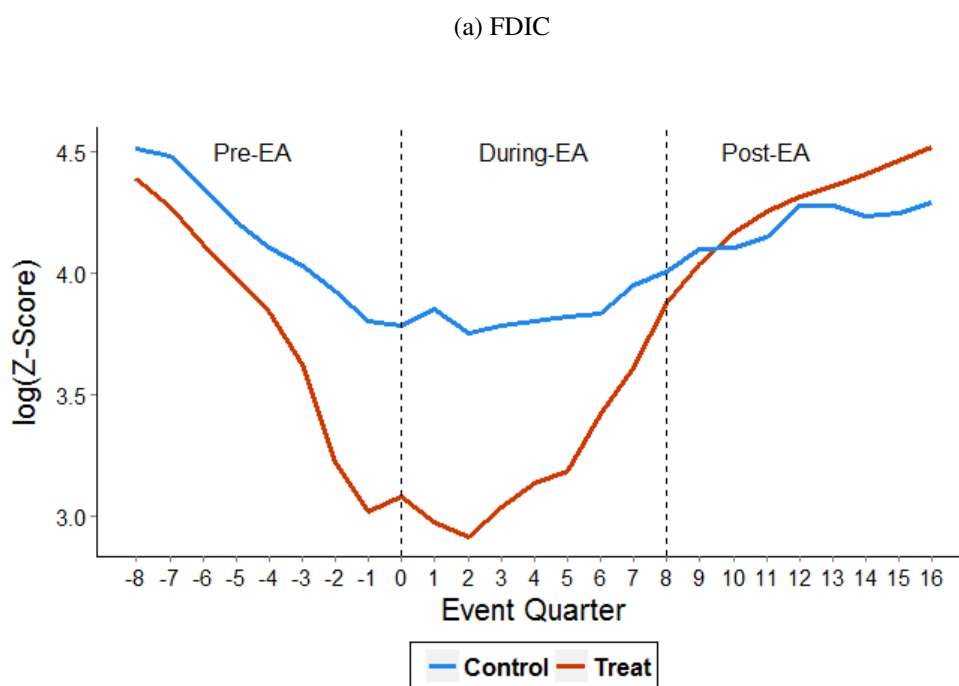
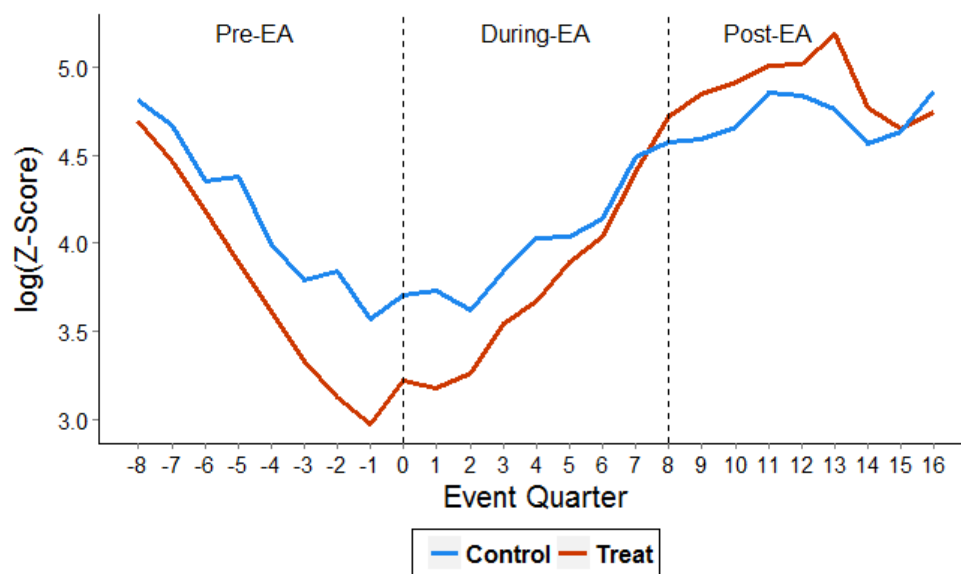


Figure B.2: **Inter-Agency Stability of Distressed Banks Throughout Enforcement Action Period**

These figures plot bank stability, as measured by Z-score, for treated and control banks between the FDIC (a), Fed (b), and OCC (c). Plotted in event time, the "Pre-EA" section represents the period prior to regulatory intervention. Clearly both sets of banks are experiencing a deterioration in stability, but only the treated banks actually come under formal corrective actions. The "During-EA" is an average of the enforcement action time period for all the treated banks. As enforcement actions last until the regulator deems the bank stable again, I calculate the average length of an enforcement action and then find the mean level of stability for the banks during that period. As this study compares only the before and after action time periods, the enforcement action period is included largely for continuity rather than interpretation. The "Post-EA" portion is the period following the removal of formal sanctions against a distressed bank.



(b) Fed



(c) OCC

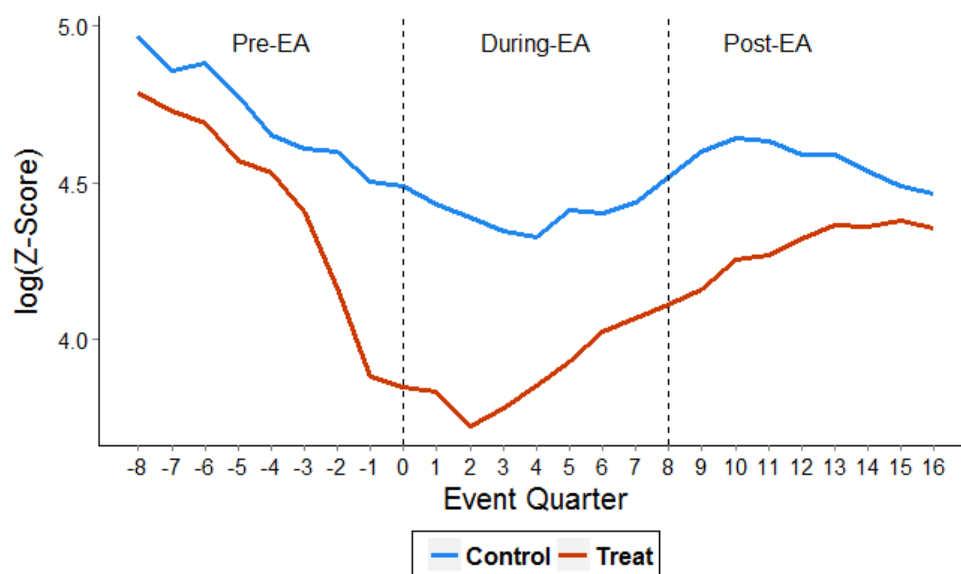


Figure B.3: **Histogram of Regulator and Type of Enforcement Action Type Distribution**

These figures present the distribution of the treated sample of banks. Figure 3(a) shows the regulator distribution of the treated banks, while Figure 3(b) plots the distribution for the type of corrective action used against banks.

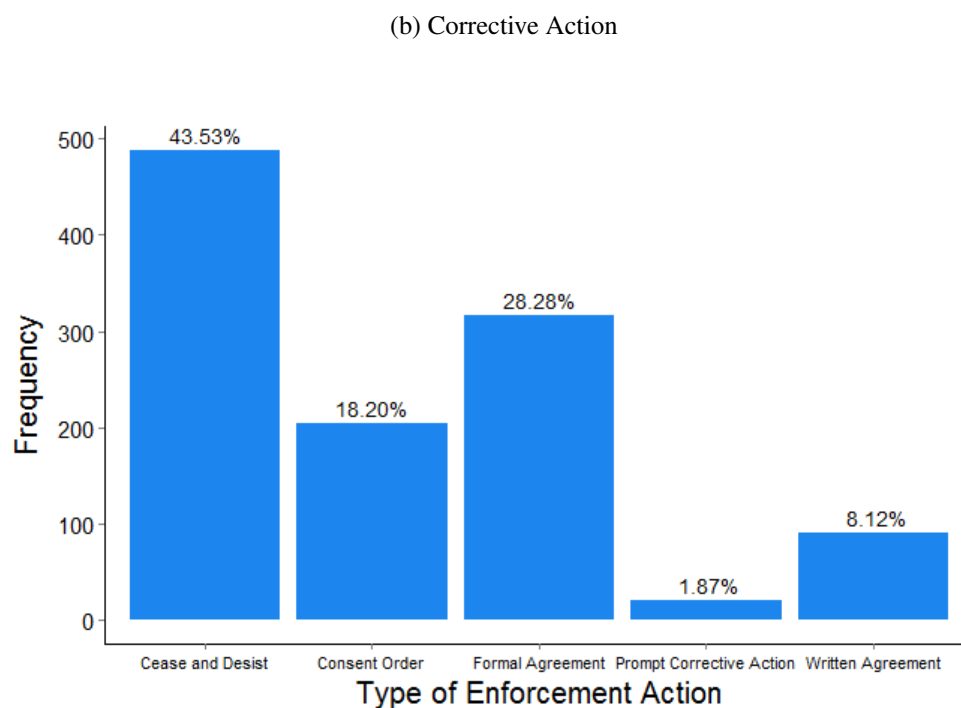
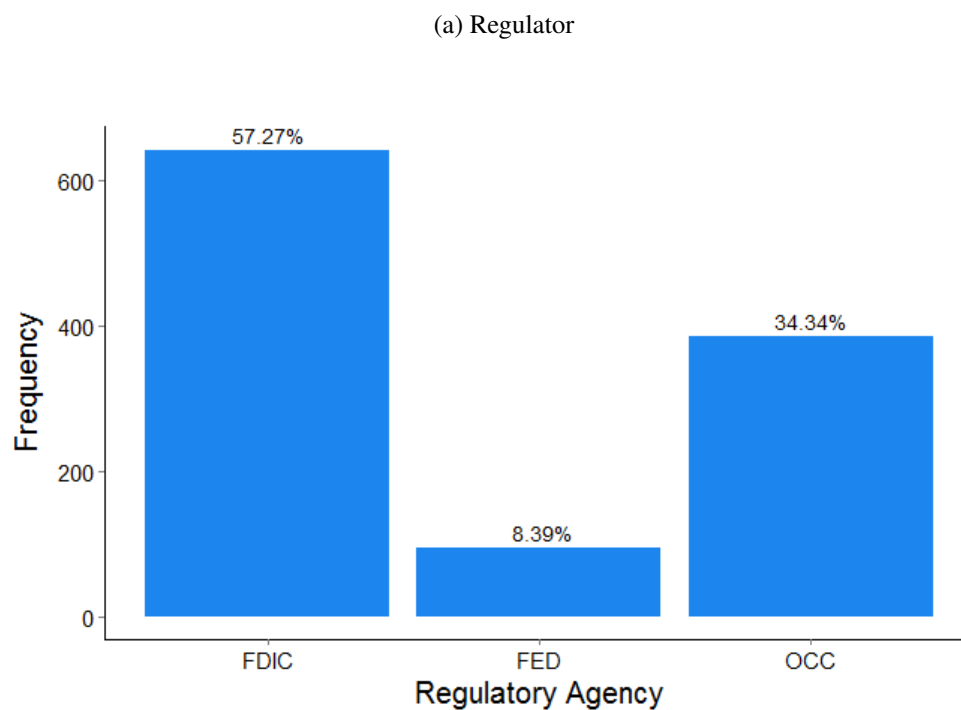


Figure B.4: **Timing of Intervention in Distressed Banks**

This figure presents the time series of formal corrective action probabilities by regulator (i.e., the survival function) implied by the hazard model in Table B.13.

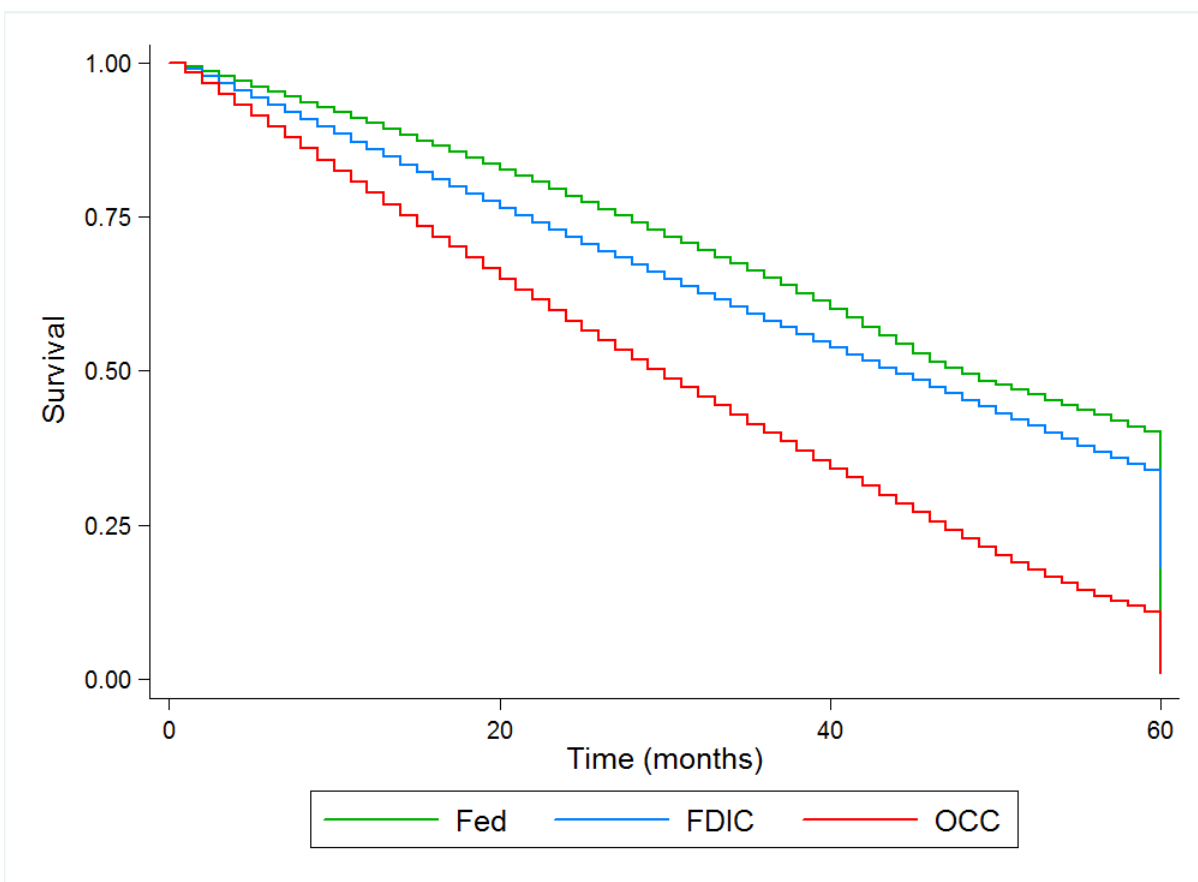


Table B.1: Descriptive Statistics of Bank Sample

The sample time period is between 2003 and 2013, with the treatment group consisting of those banks subject to formal regulatory intervention, while the control group is the set of similarly distressed banks that narrowly avoided formal regulatory sanctions.

<b>Panel A: All Banks</b>						
	Obs	Mean	Median	SD	Min	Max
Assets	1,925	485,854	151,067	1,400,399	8,506	12,669,407
Deposits	1,925	373,365	125,458	999,537	1,248	8,869,893
Z-Score	1,925	146	102	158	0	1070
Bad Loans/Assets	1,925	0.0151	0.0080	0.0192	0.0000	0.0899
Capital/Assets	1,925	0.1069	0.0956	0.0581	0.0083	0.8114
ROA	1,925	0.0017	0.0026	0.0048	-0.0184	0.0193
ROE	1,925	0.0164	0.0260	0.0495	-0.2064	0.1054
<b>Panel B: Treat Banks</b>						
	Obs	Mean	Median	SD	Min	Max
Assets	1,086	477,455	149,042	1,381,607	8,506	12,669,407
Deposits	1,086	366,994	123,106	993,711	1,248	8,869,893
Z-Score	1,086	139	96	155	0	1070
Bad Loans/Assets	1,086	0.0151	0.0082	0.0191	0.0000	0.0899
Capital/Assets	1,086	0.1086	0.0950	0.0627	0.0083	0.8114
ROA	1,086	0.0014	0.0024	0.0051	-0.0184	0.0193
ROE	1,086	0.0027	0.0246	0.0517	-0.2064	0.1054
<b>Panel C: Control Banks</b>						
	Obs	Mean	Median	SD	Min	Max
Assets	916	494,992	153,369	1,420,528	8,506	12,669,407
Deposits	916	380,296	128,082	1,005,808	1,248	8,869,893
Z-Score	916	153	110	160.2000	0	1070
Bad Loans/Assets	916	0.0151	0.0078	0.0194	0.0000	0.0899
Capital/Assets	916	0.1051	0.0961	0.0526	0.0083	0.8114
ROA	916	0.0019	0.0027	0.0044	-0.0184	0.0193
ROE	916	0.0187	0.0274	0.0468	-0.2064	0.1054

Table B.2: **Pairwise Comparison of Treatment and Control Sample**

The sample begins with all banks between 2003 and 2013. The treatment group is all banks subject to formal corrective regulatory actions over the sample period, and the pre-matched control group is just the full sample of banks that never experienced regulatory intervention over the sample period. This table presents the pairwise comparison before and after matching. A full description of the matching method and covariates used are described in Section 4. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels.

	Pre-Match			Post-Match		
	Full Sample	Treat	T-Diff	Control	Treat	T-Diff
Size	11.87	12.02	–	12.16	12.17	–
	0.00	0.01	-22.85***	0.01	0.01	-0.03
Bad Loans/Assets	0.01	0.02	–	0.02	0.02	–
	0.00	0.00	-13.00***	0.00	0.00	-2.29**
Capital/Assets	0.12	0.10	–	0.10	0.10	–
	0.00	0.00	34.77***	0.00	0.00	1.62*
# of Banks	8.862	1.292		916	1.086	

Table B.3: Effectiveness of Regulatory Enforcement Actions

Difference in differences estimates of the effect of enforcement actions. *treat* is an indicator variable of whether the bank was subject to regulatory intervention. *after* indicates whether the intervention period has ended. The period in which a bank is subject to intervention is removed in order to ensure a well defined *before* and *after* period. The difference in differences estimates are calculated using the 2-stage methodology for rolling treatments suggested by Bertrand et al. (2004). The dependent variable is regressed on a full panel with time and firm fixed effects and relevant covariates in the first stage. The residuals for the *treat* group are the regressed on the *after* dummy variable. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels.

<b>All Banks</b>		
	log(Z-score)	Capital/Assets
treat × after	0.1465*** (0.030)	0.0031*** (0.001)
Controls	Yes	Yes
Firms FE	Yes	Yes
Year-Qtr FE	Yes	Yes
# of Banks	2,008	2,008
Obs	22,606	22,606
R-squared	0.5932	0.7130

Table B.4: Effectiveness of Regulatory Enforcement Actions Across Agencies

Difference in differences estimates of the effect of enforcement actions on bank stability by regulator. *treat* is an indicator variable of whether the bank was subject to regulatory intervention. *after* indicates whether the intervention period has ended. The period in which a bank is subject to intervention is removed in order to ensure a well defined *before* and *after* period. The difference in differences estimates are calculated using the 2-stage methodology for rolling treatments suggested by Bertrand et al. (2004). The dependent variable is regressed on a full panel with time and firm fixed effects and relevant covariates in the first stage. The residuals for the *treat* group are the regressed on the *after* dummy variable. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels.

<b>Panel A: FDIC Banks</b>		
	log(Z-score)	Capital/Assets
treat×after	0.2205*** (0.042)	0.0042*** (0.001)
Controls	Yes	Yes
Firms FE	Yes	Yes
Year-Qtr FE	Yes	Yes
# of Banks	1,166	1,166
Obs	13,176	13,176
R-squared	0.5930	0.8138
<b>Panel B: Fed Banks</b>		
	log(Z-score)	Capital/Assets
treat×after	0.3923*** (0.078)	0.0045*** (0.002)
Controls	Yes	Yes
Firms FE	Yes	Yes
Year-Qtr FE	Yes	Yes
# of Banks	176	176
Obs	1,864	1,864
R-squared	0.6308	0.7219
<b>Panel C: OCC Banks</b>		
	log(Z-score)	Capital/Assets
treat×after	-0.0227 (0.049)	0.0010 (0.002)
Controls	Yes	Yes
Firms FE	Yes	Yes
Year-Qtr FE	Yes	Yes
# of Banks	664	664
Obs	7,567	7,567
R-squared	0.5586	0.7195

Table B.5: **Difference in Regulatory Efficacy Between FDIC Districts**

Difference in differences estimates of the effect of FDIC district enforcement actions on bank stability by regulator. *treat* is an indicator variable of whether the bank was subject to regulatory intervention. *after* indicates whether the intervention period has ended. The period in which a bank is subject to intervention is removed in order to ensure a well defined *before* and *after* period. The city variable is an indicator for which of the 8 FDIC districts the bank is in. The difference in differences estimates are calculated using the 2-stage methodology for rolling treatments suggested by Bertrand et al. (2004). The dependent variable is regressed on a full panel with time and firm fixed effects and relevant covariates in the first stage. The residuals for the *treat* group are the regressed on the *after* dummy variable. The interaction of the *treat*×*after* with the FDIC district dummy provides the marginal treatment effect for each district on enforcement action efficacy. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels.

	log(Z-score)	Capital/Assets
treat×after×Atlanta	0.096 (0.121)	0.0029 (0.004)
treat×after×Boston	-0.0194 (0.183)	0.0017 (0.009)
treat×after×Chicago	-0.0015 (0.089)	-0.0011 (0.002)
treat×after×Dallas	0.2448** (0.101)	0.0086*** (0.003)
treat×after×Kansas City	0.3770*** (0.082)	0.0052** (0.002)
treat×after×Memphis	0.2531** (0.114)	0.0059* (0.003)
treat×after×New York	0.0157 (0.154)	0.0025 (0.003)
treat×after×San Francisco	0.2713*** (0.082)	0.0038 (0.004)
Controls	Yes	Yes
Firms FE	Yes	Yes
Year-Qtr FE	Yes	Yes
# of Banks	1,166	1,166
Obs	13,176	13,176
R-squared	0.5950	0.8211

Table B.6: **Difference in Regulatory Efficacy Between Fed Districts**

Difference in differences estimates of the effect of Fed district enforcement actions on bank stability by regulator. *treat* is an indicator variable of whether the bank was subject to regulatory intervention. *after* indicates whether the intervention period has ended. The period in which a bank is subject to intervention is removed in order to ensure a well defined *before* and *after* period. The city variable is an indicator for which of the 10 applicable Fed districts the bank is in (note that the New York and Boston districts did not have sufficient treatment observations and are excluded). The difference in differences estimates are calculated using the 2-stage methodology for rolling treatments suggested by Bertrand et al. (2004). The dependent variable is regressed on a full panel with time and firm fixed effects and relevant covariates in the first stage. The residuals for the *treat* group are the regressed on the *after* dummy variable. The interaction of the *treat*×*after* with the Fed district dummy provides the marginal treatment effect for each district on enforcement action efficacy. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels.

	log(Z-score)	Capital/Assets
treat×after×Philadelphia	-0.2601*** (0.044)	-0.0054*** (0.001)
treat×after×Cleveland	0.3475* (0.195)	-0.0019 (0.006)
treat×after×Richmond	0.2052 (0.254)	-0.0038 (0.005)
treat×after×Atlanta	0.3439 (0.247)	0.0081 (0.009)
treat×after×Chicago	0.4487*** (0.153)	0.0081** (0.004)
treat×after×St. Louis	0.4315* (0.229)	0.0036 (0.002)
treat×after×Minneapolis	0.4533*** (0.151)	0.0006 (0.002)
treat×after×Kansas City	0.3590** (0.138)	0.0031 (0.003)
treat×after×Dallas	0.4376* (0.236)	0.0047*** (0.001)
treat×after×San Francisco	0.5892** (0.285)	0.0023 (0.004)
Controls	Yes	Yes
Firms FE	Yes	Yes
Year-Qtr FE	Yes	Yes
# of Banks	176	176
Obs	1,864	1,864
R-squared	0.6302	0.7207

Table B.7: **Difference in Regulatory Efficacy Between OCC Districts**

Difference in differences estimates of the effect of OCC district enforcement actions on bank stability by regulator. *treat* is an indicator variable of whether the bank was subject to regulatory intervention. *after* indicates whether the intervention period has ended. The period in which a bank is subject to intervention is removed in order to ensure a well defined *before* and *after* period. The city variable is an indicator for which of the 4 OCC districts the bank is in. The difference in differences estimates are calculated using the 2-stage methodology for rolling treatments suggested by Bertrand et al. (2004). The dependent variable is regressed on a full panel with time and firm fixed effects and relevant covariates in the first stage. The residuals for the *treat* group are the regressed on the *after* dummy variable. The interaction of the *treat*×*after* with the OCC district dummy provides the marginal treatment effect for each district on enforcement action efficacy. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels.

	log(Z-score)	Capital/Assets
<i>treat</i> × <i>after</i> ×Central	0.1402* (0.078)	0.0004 (0.002)
<i>treat</i> × <i>after</i> ×Western	-0.0504 (0.062)	0.0027 (0.003)
<i>treat</i> × <i>after</i> ×Southern	-0.1745** (0.074)	0.0018 (0.002)
<i>treat</i> × <i>after</i> ×Northeastern	0.0497 (0.153)	0.0026 (0.003)
Controls	Yes	Yes
Firms FE	Yes	Yes
Year-Qtr FE	Yes	Yes
# of Banks	664	664
Obs	7,567	7,567
R-squared	0.5823	0.7943

Table B.8: Annual Regulatory Budget per Bank

Difference in differences estimates of the effect of regulatory resource constraints on bank stability, separated by regulator. Resource constraints are proxied for by *annual budget per banks*, which is the natural log of the ratio of a regulator's annual budget to number of banks. *treat* is an indicator variable of whether the bank was subject to regulatory intervention. *after* indicates whether the intervention period has ended. The period in which a bank is subject to intervention is removed in order to ensure a well defined *before* and *after* period. The difference in differences estimates are calculated using the 2-stage methodology for rolling treatments suggested by Bertrand et al. (2004). The dependent variable is regressed on a full panel with time and firm fixed effects and relevant covariates in the first stage. The residuals for the *treat* group are the regressed on the *after* dummy variable. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels.

<b>Panel A: FDIC Banks</b>		
	log(Z-score)	Capital/Assets
budget per bank	-0.3754 (0.536)	0.0211*** (0.003)
treat×after	-2.2455*** (0.793)	-0.0152 (0.024)
treat×after×budget per bank	0.1827*** (0.060)	0.0014 (0.002)
Controls	Yes	Yes
Firms FE	Yes	Yes
Year-Qtr FE	Yes	Yes
# of Banks	1,166	1,166
Obs	13,176	13,176
R-squared	0.5949	0.8211
<b>Panel B: Fed Banks</b>		
	log(Z-score)	Capital/Assets
budget per bank	–	0.0317*** (0.010)
treat×after	-9.6463** (4.688)	-0.2186* (0.117)
treat×after×budget per bank	0.6543** (0.309)	0.0144* (0.008)
Controls	Yes	Yes
Firms FE	Yes	Yes
Year-Qtr FE	Yes	Yes
# of Banks	176	176
Obs	1,864	1,864
R-squared	0.6321	0.7178

<b>Panel C: OCC Banks</b>		
	log(Z-score)	Capital/Assets
budget per bank	-0.7982*** (0.098)	0.0170*** (0.002)
treat×after	-1.0203 (2.171)	0.0421 (0.093)
treat×after×budget per bank	0.0723 (0.158)	-0.0029 (0.007)
Controls	Yes	Yes
Firms FE	Yes	Yes
Year-Qtr FE	Yes	Yes
# of Banks	664	664
Obs	7,567	7,567
R-squared	0.5820	0.7930

Table B.9: **Full-Time Regulatory Employee per Bank**

Difference in differences estimates of the effect of regulatory resource constraints on bank stability, separated by regulator. Resource constraints are proxied by *fte per bank*, which is the natural log of the ratio of a regulator's full time workforce to number of banks. *treat* is an indicator variable of whether the bank was subject to regulatory intervention. *after* indicates whether the intervention period has ended. The period in which a bank is subject to intervention is removed in order to ensure a well defined *before* and *after* period. The difference in differences estimates are calculated using the 2-stage methodology for rolling treatments suggested by Bertrand et al. (2004). The dependent variable is regressed on a full panel with time and firm fixed effects and relevant covariates in the first stage. The residuals for the *treat* group are the regressed on the *after* dummy variable. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels.

<b>Panel A: FDIC Banks</b>		
	log(Z-score)	Capital/Assets
fte per bank	-0.3044*	0.0420***
	(0.158)	(0.005)
treat×after	0.0630	0.0011
	(0.055)	(0.001)
treat×after×fte per bank	0.2620**	0.0048
	(0.116)	(0.003)
Controls	Yes	Yes
Firms FE	Yes	Yes
Year-Qtr FE	Yes	Yes
# of Banks	1,166	1,166
Obs	13,176	13,176
R-squared	0.5949	0.8211
<b>Panel B: Fed Banks</b>		
	log(Z-score)	Capital/Assets
fte per bank	–	-0.7643***
		(0.232)
treat×after	-16.5346**	-0.2940*
	(8.174)	(0.171)
treat×after×fte per bank	5.3606**	0.0941*
	(2.602)	(0.055)
Controls	Yes	Yes
Firms FE	Yes	Yes
Year-Qtr FE	Yes	Yes
# of Banks	176	176
Obs	1,864	1,864
R-squared	0.6321	0.7178

<b>Panel C: OCC Banks</b>		
	log(Z-score)	Capital/Assets
fte per bank	–	0.0443*** (0.006)
treat × after	-0.4149 (0.305)	0.0084 (0.010)
treat × after × fte per bank	0.5829 (0.460)	-0.0098 (0.015)
Controls	Yes	Yes
Firms FE	Yes	Yes
Year-Qtr FE	Yes	Yes
# of Banks	664	664
Obs	7,567	7,567
R-squared	0.5820	0.7943

Table B.10: **Technology Investment per Bank**

Difference in differences estimates of the effect of regulatory resource constraints on bank stability, separated by regulator. Resource constraints are proxied by *tech per bank*, which is the natural log of the ratio of a regulator's annual technology expenditure to number of banks. *treat* is an indicator variable of whether the bank was subject to regulatory intervention. *after* indicates whether the intervention period has ended. The period in which a bank is subject to intervention is removed in order to ensure a well defined *before* and *after* period. The difference in differences estimates are calculated using the 2-stage methodology for rolling treatments suggested by Bertrand et al. (2004). The dependent variable is regressed on a full panel with time and firm fixed effects and relevant covariates in the first stage. The residuals for the *treat* group are the regressed on the *after* dummy variable. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels.

<b>Panel A: FDIC Banks</b>		
	log(Z-score)	Capital/Assets
tech per bank	–	–
treat×after	8.1164*** (2.387)	0.0247 (0.090)
treat×after×tech per bank	-0.7630*** (0.230)	-0.0021 (0.009)
Controls	Yes	Yes
Firms FE	Yes	Yes
Year-Qtr FE	Yes	Yes
# of Banks	1,166	1,166
Obs	13,176	13,176
R-squared	0.5949	0.8211
<b>Panel B: Fed Banks</b>		
	log(Z-score)	Capital/Assets
tech per bank	–	0.0420*** (0.013)
treat×after	-8.2312* (4.957)	-0.1662* (0.095)
treat×after×tech per bank	0.6970* (0.405)	0.0137* (0.008)
Controls	Yes	Yes
Firms FE	Yes	Yes
Year-Qtr FE	Yes	Yes
# of Banks	176	176
Obs	1,864	1,864
R-squared	0.6321	0.7178

<b>Panel C: OCC Banks</b>		
	log(Z-score)	Capital/Assets
tech per bank	-0.5786*** (0.071)	0.0102*** (0.001)
treat×after	-1.8722 (1.644)	0.0013 (0.061)
treat×after×tech per bank	0.1714 (0.153)	0.0000 (0.006)
Controls	Yes	Yes
Firms FE	Yes	Yes
Year-Qtr FE	Yes	Yes
# of Banks	664	664
Obs	7,567	7,567
R-squared	0.5820	0.7943

Table B.11: Portion of Distressed Banks Subject to Formal Sanctions

Difference in differences estimates of the effect of the degree of formal sanction use against distressed banks, separated by regulator. Degree of sanctions is proxied by *enforcement ratio*, which is the ratio of banks subject to enforcement actions divided by the number of distressed banks. Distressed banks are identified as those banks who have nonperforming loans to capital ratios higher than one standard deviation above the mean level. *treat* is an indicator variable of whether the bank was subject to regulatory intervention. *after* indicates whether the intervention period has ended. The period in which a bank is subject to intervention is removed in order to ensure a well defined *before* and *after* period. The difference in differences estimates are calculated using the 2-stage methodology for rolling treatments suggested by Bertrand et al. (2004). The dependent variable is regressed on a full panel with time and firm fixed effects and relevant covariates in the first stage. The residuals for the *treat* group are the regressed on the *after* dummy variable. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels.

<b>Panel A: FDIC Banks</b>		
	log(Z-score)	Capital/Assets
enforcement ratio	–	-0.0554*** (0.007)
treat × after	0.4283*** (0.110)	0.0049 (0.003)
treat × after × enforcement ratio	-0.4657*** (0.169)	-0.0031 (0.005)
Controls	Yes	Yes
Firms FE	Yes	Yes
Year-Qtr FE	Yes	Yes
# of Banks	1,166	1,166
Obs	13,176	13,176
R-squared	0.5928	0.8209
<b>Panel B: Fed Banks</b>		
	log(Z-score)	Capital/Assets
enforcement ratio	-2.4583 (6.849)	0.2384** (0.094)
treat × after	0.6927*** (0.204)	0.0104** (0.005)
treat × after × enforcement ratio	-0.4845* (0.251)	-0.0121** (0.006)
Controls	Yes	Yes
Firms FE	Yes	Yes
Year-Qtr FE	Yes	Yes
# of Banks	176	176
Obs	1,864	1,864
R-squared	0.6299	0.7204

<b>Panel C: OCC Banks</b>		
	log(Z-score)	Capital/Assets
enforcement ratio	3.1430 (1.983)	0.3593*** (0.062)
treat × after	-0.2481 (0.283)	-0.0164* (0.010)
treat × after × enforcement ratio	0.2844 (0.337)	0.0231* (0.012)
Controls	Yes	Yes
Firms FE	Yes	Yes
Year-Qtr FE	Yes	Yes
# of Banks	664	664
Obs	7,567	7,567
R-squared	0.5808	0.7943

Table B.12: **Distance to Regulatory Field Office**

Difference in differences estimates of the effect of distance to regulatory field office on bank stability, separated by regulator. *treat* is an indicator variable of whether the bank was subject to regulatory intervention. *after* indicates whether the intervention period has ended. The period in which a bank is subject to intervention is removed in order to ensure a well defined *before* and *after* period. The difference in differences estimates are calculated using the 2-stage methodology for rolling treatments suggested by Bertrand et al. (2004). The dependent variable is regressed on a full panel with time and firm fixed effects and relevant covariates in the first stage. The residuals for the *treat* group are regressed on the *after* dummy variable. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels.

<b>Panel A: FDIC Banks</b>		
	log(Z-score)	Capital/Assets
<i>treat</i> × <i>after</i>	0.1611*** (0.062)	0.0030* (0.002)
<i>treat</i> × <i>after</i> × distance	0.0000 (0.000)	0.0000 (0.000)
Controls	Yes	Yes
Firms FE	Yes	Yes
Year-Qtr FE	Yes	Yes
# of Banks	1,166	1,166
Obs	13,176	13,176
R-squared	0.5949	0.8211
<b>Panel B: Fed Banks</b>		
	log(Z-score)	Capital/Assets
<i>treat</i> × <i>after</i>	0.2985*** (0.083)	0.0031 (0.002)
<i>treat</i> × <i>after</i> × distance	0.0001 (0.000)	-0.0000 (0.000)
Controls	Yes	Yes
Firms FE	Yes	Yes
Year-Qtr FE	Yes	Yes
# of Banks	176	176
Obs	1,864	1,864
R-squared	0.6321	0.7178

<b>Panel C: OCC Banks</b>		
	log(Z-score)	Capital/Assets
treat×after	-0.0288 (0.068)	0.0019 (0.002)
treat×after×distance	0.0000 (0.000)	-0.0000 (0.000)
Controls	Yes	Yes
Firms FE	Yes	Yes
Year-Qtr FE	Yes	Yes
# of Banks	664	664
Obs	7,567	7,567
R-squared	0.5820	0.7943

Table B.13: **Timing of Regulatory Intervention**

Panel A presents the regression results on the likelihood of corrective action against a distressed bank. The sample is constructed by first identifying distressed banks, which are those with non-performing loans to assets of at least one standard deviation above the mean. Panel B presents the regression results on the likelihood of successfully completing an enforcement action. Size is the log of assets, capital/assets is a proxy for bank stability, non-performing assets/capital is a measure of asset quality coupled with the ability for a bank to withstand the losses of those bad assets, loans/assets captures liquidity, and distance measures the miles between a bank and the regulatory field office. All variables are standardized with mean of 0, standard deviation of 1. The coefficients represent the change in hazard rates, which can be calculated by:  $\beta - 1$ . The interpretation is therefore  $(\beta - 1) \times 100$  percent change in the hazard rate. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels.

	All Banks	FDIC	Fed	OCC
size	0.9883* (0.007)	1.0173** (0.008)	1.3731*** (0.038)	1.0630*** (0.014)
capital/assets	0.9110*** (0.008)	0.9361*** (0.010)	0.7994*** (0.034)	0.9157*** (0.013)
non-performing as- sets/capital	1.1512*** (0.009)	1.0410*** (0.010)	0.8545*** (0.031)	1.0254* (0.014)
loans/assets	0.8778*** (0.006)	1.0319*** (0.009)	1.0981*** (0.038)	0.8815*** (0.010)
distance	0.9095*** (0.007)	0.9622*** (0.008)	1.4475*** (0.037)	0.9960 (0.016)
Obs	19,221	9,312	1,988	7,921
R-squared				