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## Bank Monitoring with On-Site Inspections

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## Bank Monitoring with On-Site Inspections

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Although a seminal body of theoretical literature asserts that a key advantage of banks is their ability to monitor borrowers, we are the first paper to empirically examine the theoretical determinants of bank monitoring within non-syndicated loans. Using a proprietary set of transaction-level database of nearly 30,000 multiple-draw construction loans, we observe the frequency at which the bank monitors these loans by conducting on-site inspections, the contents of the reports, and the borrower actions over the life of the loan. Consistent with theoretical predictions, we find evidence that banks tradeoff monitoring with many types of favorable loan origination terms. Monitoring is also less frequent for loans where the bank has a prior relationship with either the borrower or project contractor, suggesting that banks may be transferring information across projects. Furthermore, we show that negative on-site inspection reports are associated with a greater likelihood of banks denying draw requests, indicating that the information that banks collect during the monitoring process is important to their decision-making. In subsequent analysis, we provide a comprehensive analysis on the determinants of construction loan default and show that more monitoring ultimately decreases loan default within an instrumental variable framework.

**Keywords:** bank monitoring, financial crisis, construction loan, failed bank

**JEL Codes:** G21, G51, G01, G33

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## 1. Introduction

As increasing amounts of lending activity migrate away from banks and into non-bank finance companies,<sup>1</sup> only a few categories of loans remain largely in the hands of modern banks. Using Call Report data, Figure 1 shows that lending in commercial real estate (CRE) loans has increased as a share of bank balance sheets over time, with the largest proportional increases occurring in small banks. It is well established that CRE lending is inherently risky, and construction and land development (CLD) loans are widely considered the riskiest sub-category of such bank lending (Balla, Mazur, Prescott, and Walter, 2019). Banks may remain dominant in these loan categories because of their comparative advantage in managing complex lending relationships, such as through monitoring loans.

Even after performing due diligence through underwriting to screen out unacceptable borrowers (adverse selection), lenders must expend resources and monitor the loans to temper borrower incentives to invest sub-optimally (moral hazard). A large theoretical body of literature examining the unique features of banks suggests that a key advantage that banks have over non-banks is the mitigation of this moral hazard problem through their superior monitoring capabilities (Diamond, 1984; Fama, 1985; James, 1987; Diamond and Rajan, 2001; Kashyap, Rajan, and Stein, 2002). Some models suggest that by specializing in certain asset classes, banks have enhanced incentives to monitor (Winton, 1999), and greater levels of monitoring can ultimately lead to improvements in the quality of their loan portfolios (Boot and Thakor, 1997; Winton, 1999). However, because *direct* evidence of monitoring is rarely observed, empirical papers struggle to test many theoretical models of monitoring.

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<sup>1</sup> For example, fintechs and non-bank lenders increasingly originate many types of loans, securitize them, then sell them to private investors or government entities. Existing studies have established these patterns in mortgage lending (Buchak, Matvos, Piskorski, and Seru, 2018), student loans (Berman and Stivers, 2016), and consumer finance assets, such as automobile loans, credit card receivables, and student loans (Cetorelli, Mandell and Mollineaux, 2012). The two remaining asset classes are commercial and industrial loans and commercial real estate loans, including construction loans (Cetorelli, Mandell and Mollineaux, 2012). See also Fessenden and Muething (2017) for the rising importance of commercial real estate lending for banks.

In this paper, we fill this gap in the literature by empirically examining the determinants of monitoring, how banks use the information collected when they monitor, and whether monitoring affects loan outcomes. Using a proprietary transaction-level dataset of nearly 30,000 construction loans, primarily for residential properties, that spans ten years from a large bank, we construct a novel measure of monitoring: in-person inspections of the construction site by bank staff or bank-contracted, third-party inspectors (“on-site inspections”). For each construction loan in our sample, we observe the timing and frequency of these inspections, along with the text contained in the inspection reports. This allows us to quantify the frequency at which banks obtain information on the project’s progress and how banks use the information contained within these reports.

We focus on this bank’s construction loans because they are uniquely suited for this type of analysis and possess many characteristics which theory predicts would heighten bank incentives to monitor. For example, the bank had a loan portfolio specializing in construction loans where they retained the entirety of the loan exposure. Construction loans are also inherently risky; have an illiquid secondary market; only generate collateral as the project progresses; usually do not generate cash flow; and often lack traditional covenants that can temper monitoring incentives (Winton, 1999; Boot and Thakor, 1997; Rajan and Winton, 1995; Garleanu and Zwiebel, 2009). We also observe contract terms, origination characteristics, and borrower actions throughout the life of the loan, including line drawdowns, payments, and defaults. Thus, this bank’s construction lending portfolio provides us with an ideal laboratory to examine the factors contributing to the bank’s monitoring and how this monitoring influences loan outcomes.

Analogous to a single-family mortgage loan, construction loans typically require borrowers to contribute equity, such as a parcel of land or cash, at the time of the loan’s origination to secure the rest of the funds from the bank. Unlike many other types of loans, the bulk of the collateral backing the loan is created over the course of the loan. To alleviate the moral hazard problem of borrowers drawing down on the entire committed loan amount at once before then defaulting, construction loans are structured with pre-determined draw schedules that mandate

that the borrower make adequate progress before the bank will disburse additional funds to continue work on the project. It is common for banks to hire independent, third-party inspectors to assess and document the project's progress before approving the draw request, though not all draw requests are accompanied by on-site inspections.

We construct three loan-level measures of monitoring intensity. First, we calculate the natural log of the total number of on-site inspections over the lifetime of the loan. A second measure normalizes the number of on-site inspections by the number of days before the loan reached its terminal state at the bank, which could be maturity, rolling to a permanent loan, prepayment, or default. The third measure is the number of months until the loan's first on-site inspection. When monitoring is beneficial for banks, they may have incentives to acquire information more frequently or initiate inspections earlier. Approximately 96 percent of construction loans in our sample experience on-site inspections. The average sample loan has a term of 13.68 months, 12.52 draw attempts, 8.15 on-site inspections, and an initial inspection occurring 3.01 months after the origination date.

Relying on the predictions of several seminal theoretical models, we first examine whether banks substitute monitoring intensity (on-site inspections) with loan origination characteristics, such as price, quantity, and term to maturity. Consistent with the predictions in Diamond (1989, 1991), we find evidence of a negative relationship between on-site inspection intensity and loan spreads at origination and fees, yet a positive relationship between on-site inspection intensity and loan amount. We also find that shorter maturity loans have more frequent on-site inspections. This finding is consistent with Rajan and Winton (1995), Barclay and Smith (1995), and Park (2000), who argue that banks receive more value from monitoring shorter term loans.

Pennacchi (1988) asserts that the heart of the bank's monitoring function is to limit risk in borrowers' projects and reduce the probability of default, suggesting that banks should be more likely to monitor projects with a greater ex ante probability of default. During the housing boom prior to the financial crisis of 2008, banks implemented lax underwriting standards and

granted high risk construction loans to borrowers and projects that were less credit worthy than had historically been the case.<sup>2</sup> The granular nature of our loan documentation allows us to examine the relationship between borrower- and project-risk using proxies based on hard underwriting criteria as well as classifications of loans as made by loan officers. We find that loans to borrowers with lower credit scores and higher combined loan to value ratios (CLTV) are monitored more intensely over the course of the loan, suggesting that loans with higher risk borrowers were monitored more. Furthermore, this bank also had a special program marketed to individuals who did not necessarily have any construction experience to build their dream homes. Loans made through this program were also monitored more. Relatedly, loans flagged as “speculative,” meaning they were built to be sold later in the general market, rather than to pre-committed buyers, are also monitored more. In sum, these results suggest that while there was a nationwide trend for banks to make higher risk loans during the housing boom, banks would still attempt to manage the loan-level risks associated with these construction projects.

To the best of our knowledge, we are the first paper to examine the effect bank lending relationships with either the borrower or contractor have on monitoring. In addition to standard borrower-side risks of loan default (e.g., inability to pay back the loan), contractors introduce additional risks to the bank surrounding the progression of the underlying collateral. For example, contractors may go out of business, induce project delays, or take shortcuts that result in building quality issues. Extant theoretical models assert that banks are special because they are capable of gaining information through lending, which enhances their monitoring ability (Diamond, 1984; James, 1987; Besanko and Kanatas, 1993). If repeated interactions through relationships provide the bank with additional information that can be reusable across projects (Boot, 2000), this could lead to a decrease in monitoring. However, to the extent that the bank has additional exposure to the party doing the construction (the contractor) or the borrower, it

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<sup>2</sup> Ben S. Bernanke, the former Chairman of the Federal Reserve, said, “Stronger regulation and supervision aimed at problems with underwriting practices and lenders’ risk management would have been a more effective and surgical approach to constraining the housing bubble than a general increase in interest rates. “Lax Oversight Caused Crisis, Bernanke Says” *The New York Times*, January 3, 2010.

may monitor more to manage this concentrated exposure. Thus, we create two separate variables indicating whether the borrower or contractor has any additional construction loans with the bank. We find that both bank-contractor and bank-borrower relationships are associated with reduced monitoring. One potential interpretation for this finding is that these borrower- and contractor-bank relationships provide value to banks by reducing monitoring costs because the private information that the banks receive from monitoring is reusable and can be transferred between projects, consistent with Boot (2000).

Next, we explore the content of reports associated with the on-site inspections to examine whether banks use the information they acquire through monitoring and whether the information they acquire has consequences for borrowers. Within a panel setting, we map each loan inspection report to the draw request associated with it. Using the textual sentiments defined by Loughran and McDonald (2011), we examine the length of the inspection reports as well as the percentage of words contained in the reports that are positive or negative. We find that on-site inspection reports that are more negative are associated with more draw denials, and positive words have the opposite effect. This effect persists even after saturating the model with loan-level fixed effects, accounting for time-invariant loan-level characteristics, inspector-level effects, and day fixed effects, accounting for time trends.

After establishing that there is a strong relationship between bank incentives to monitor and their realized monitoring actions, we next demonstrate that these monitoring actions affect loan default and highlight their relative importance in relation to underwriting. A bank will monitor a performing loan to avoid or reduce credit quality deterioration, but it may also monitor loans with the highest probability of default more intensely, since the marginal benefit of each additional inspection may be greatest on the riskiest loans. To alleviate this endogeneity problem, we implement an instrumental variable (IV) framework to estimate the causal effects of monitoring. Within the IV framework, we define an instrument that influences monitoring intensity but should not directly affect loan default, controlling for the range of construction project, borrower, and loan characteristics. We exploit the fact that the draw schedules for loans

are set at the time of loan origination, and the draw requests are used by the bank as a trigger for an on-site inspection, to use the number of draws as an exogenous shifter for the number of inspections. We posit and verify that more draws are associated with more inspections. But, we also expect that draw schedules are not directly related to loan default conditional on the observables we include as controls. Within the IV framework, we establish that the negative relationship between monitoring and loan default becomes even stronger. Consistent with theoretical models, this result indicates that enhanced monitoring ultimately reduces the probability of default and improves loan performance (Boot and Thakor, 1997; Winton, 1999; Acharya, Hasan, and Saunders, 2006).

While time-varying loan-level collateral values are difficult to observe and even difficult to define for projects under construction, in subsequent analysis, we examine whether deteriorations in local economic conditions affect bank monitoring and draw request outcomes. We find that construction loans located in zip codes with growth in housing prices are less likely to be inspected and less likely to have draw requests denied, and those located in areas with higher foreclosure rates are more likely to have draw requests denied. To the extent that improvements in local economic conditions negatively correlate with the risk of borrower nonpayment, this finding is consistent with the theoretical findings in Rajan and Winton (1995).

This study provides three distinct contributions to the literature. First, leaning on an established body of theoretical models, we empirically test the determinants of bank monitoring. To the best of our knowledge, this is the first paper that directly quantifies and examines these theoretical monitoring determinants within a set of loans that are non-syndicated and made to individual borrowers. We are also the first paper to directly quantify the frequency and timing of inspections within these loans. Since this bank served a broad customer base in many markets, we believe that many of the results based on this data set are likely to be broadly representative of how banks choose their monitoring actions for construction loans and potentially other types of consumer non-syndicated loans. Second, using an instrumental variables framework and controlling for adverse selection through hard underwriting measures, we establish causally that



monitoring leads to improvements in loan performance, corroborating the predictions of numerous theoretical models that suggest that monitoring can reduce borrower moral hazard post loan origination.

Finally, this study is the first to examine the determinants of construction default in a regression framework. As the result of non-bank lending and asset securitization, bank balance sheets have become heavily concentrated in only a few loan categories, including construction lending. Construction lending on bank Call Reports totaled \$403 billion as of the fourth quarter of 2021 and was one of the primary contributors to bank failures during the financial crisis (Office of Inspector General, FDIC, 2012). Thus, it is important for regulators, academics, and banks to understand what contributes to default within this asset class.

## **2. Background and Literature**

### **a. Motivation and Related Literature**

An extensive body of theoretical models suggest that there are three primary advantages banks have over non-banks: better lending technologies, superior information producing (monitoring) abilities, and the ability to match up liquidity need between deposit-taking and loan-making (Diamond and Rajan, 2001; Kashyap, Rajan and Stein, 2002). By assuming that a financial intermediary exists that possesses superior monitoring technology (e.g., Diamond, 1991), several studies show that monitoring can positively affect loan performance (Leland and Pyle 1977; Diamond 1984, Diamond 1991; Kashyap et al, 2019). However, empirical researchers have struggled to test directly the two primary assumptions underlying this body of theoretical models: 1) banks actively monitor loans, and 2) monitoring influences loan outcomes. Although banks may monitor borrowers by requesting documents, project updates, or collateral appraisals, or by conducting phone calls or on-site inspections over the course of the loan, these direct monitoring measures are not often observable to empirical researchers using commercially available databases.

Monitoring can be costly for banks. Banks may choose to dedicate resources to directly acquiring information corresponding to an existing loan, instead of acquiring more business.

Further, acquiring loan-specific information requires training to evaluate real estate projects. Third-party experts conduct most on-site inspections contained within our sample. But, monitoring provides the lender with real time information about the project progress and borrower conditions, allowing the bank to manage credit more effectively if it becomes necessary. Monitoring also incentivizes borrowers to complete projects as promised lest they lose access to the rest of a credit line or future credit.

In contrast to directly measuring the frequency or intensity of borrower-lender interactions, several studies have proxied for monitoring by using financial covenants (Wang and Xia, 2014), syndicate structure (Lee and Mullineaux, 2004; Sufi, 2007; Beatty, Liao, and Zhang, 2019), or distance between the bank and the borrower (Petersen and Rajan, 2002; Degryse and Ongena, 2005). Others have attempted to quantify the benefits of unobserved monitoring empirically by examining stock returns (James, 1987; Focarelli, Pozzolo, and Casolaro, 2008; Addoum and Murfin, 2020) or debt yields (Datta, Iskandar-Datta, and Patel, 1999). Using a more direct monitoring measure, Cerqueiro, Ongena, and Roszbach (2016) show the value of collateral is an important determinant of monitoring, as proxied by the number of months between instances where the bank reviews borrower documentation, though they do not examine its effect on loan outcomes, such as default.

To the best of our knowledge, our paper is the first study to directly document the on-site monitoring process for any sample of non-syndicated loans to individual borrowers, primarily due to a lack of data available to other researchers. Theoretical models suggest that the interaction between multiple lenders can have complicated effects on individual lender incentives to mitigate adverse selection and moral hazard problems (Diamond 1984; Ramakrishnan and Thakor 1984; Fama 1985). Thus, our study also complements the analysis in Gustafason, Ivanov, and Meisenzahl (2021), who use textual analysis to recover various instances of active monitoring in syndicated loans to corporate borrowers. They highlight the role that covenants and syndicate structures, two determinants of loan monitoring not generally applicable to our study, play in the existence of active bank monitoring. We document that the

bank monitoring of our loans is dramatically different from the group of syndicated loans that they study. Whereas nearly all loans in our sample are monitored regularly (an average of 2.31 times per hundred days), they show that only 20 percent of syndicated loans are monitored at any point during their lifetime. By focusing on the frequency and timing of bank monitoring, the contents of the on-site inspection reports, and implementing an instrumental variables framework, we meaningfully contribute to the literature by directly speaking to the determinants of monitoring and showing that banks use the information that they collect monitoring. Furthermore, we are the first paper to empirically show that bank monitoring has a causal effect on loan performance.

The literature on construction lending is very sparse. Some early industry-based case studies that predate the savings and loan crisis highlight the risks associated with residential and CRE lending and establish their importance to economic growth (Rogers, 1975; Tockarshewsky, 1977; Lusht and Leidenberger, 1979). Other studies document that lending in construction and real estate has been an underlying cause of many historical financial crises both within the U.S. and globally (Reinhart and Rogoff, 2011; Friend, Glenos, and Nichols, 2013; Fenn and Cole, 2008) and bank failures associated with these crisis times (Balla, Mazur, Prescott, and Walter, 2019). However, very little is known about what contributes to the probability of default within this asset class.

Our paper is closely related to Johnston-Ross, Nichols, and Shibut (2021). In a recent working paper, the authors use a different proprietary FDIC dataset spanning several banks to examine whether certain loan-level, bank-level, or market-level factors explain loss given default (LGD) in construction loans. The authors are unable to examine many important loan-level attributes, such as characteristics of the loan at origination or loan monitoring. In contrast, our paper uses more granular loan-level data from one large anonymous financial institution, and the detailed nature of our loan-level data allows us to complement their study. We speak to the probability of default (PD) of construction loans in an operating bank, as opposed to the conditional losses (LGD) following bank closure.

## b. Institutional Background

When obtaining a construction loan, investors frequently form a project-specific Limited Liability Corporation (LLC) that acts as the official borrower and place the property into the LLC. Although it is possible for a builder to take on the role of an investor/borrower, the borrower typically hires a third-party builder to perform the construction tasks and complete any necessary regulatory approvals prior to breaking ground. Less sophisticated individual homeowners may choose not to set up an LLC. Although banks require borrowers to provide necessary information and documentation to underwrite and monitor the loan, the bank ultimately relies on the buyer's reported intent and the information available to assess the project, since a large share of the collateral behind construction loans is created over the course of the loan. As a result, it is common for lenders to require borrowers to provide personal guarantees for the construction loans. These guarantees provide the lender recourse in the event of default if the value of the land or incomplete project pledged as collateral is insufficient for loan repayment.

Construction loans have relatively short maturities that correspond to the phases of development. In the case of an office complex, the borrower may obtain a land development loan to build a parking lot and prepare the land for utility hookups. Subsequently, the borrower may obtain a construction loan to build the standing components of the complex. These loans are typically structured in tranches, where the next segment of the committed balance will only be disbursed to the borrower when certain completion thresholds are met. The construction loan documents provide the pre-determined disbursement schedule corresponding to the various construction phases. Since construction projects rarely generate cash flows to the borrower until construction is complete, the loans are structured such that the borrower does not make principal payments until maturity. At that time, the borrower can repay the principal and interest associated with the construction loan with their own funds, a loan from another bank, or roll the loan into a permanent mortgage with the bank that originated the construction loan. The terms of

this permanent loan either may have been arranged at the beginning of the project or are negotiated at the end of the construction.

In comparison to other types of mortgages, monitoring for construction loans is considerably more labor-intensive and important. Since the project's collateral is being created over the course of the project, banks must acquire detailed information about the regulatory approval process, the details of the construction itself, and local market conditions. The lender determines the timing and amount of loan draws and payments based on the status of the construction and the covenants. The lender also determines any necessary adjustments to the loan. Adjustments are common and can broadly occur as the result of unforeseen construction problems, such as changes to timing, input prices, or market changes.

There are two categories of default associated with construction loans: maturity defaults and term defaults. Maturity defaults occur when the borrower is unable to pay off the construction loan in full at the end of the term; this typically occurs when borrowers are unable to sell collateral at an adequate price or obtain permanent financing. Lenders typically initiate term defaults when they do not believe that the borrower will be able to make payments, possibly due to deteriorating market conditions, lack of project progression, or insufficient anticipated demand. In these scenarios, the lender may call the loan or refuse to allow future disbursements.

### **3. Data**

This paper uses construction loan data from the servicing system of a large bank that failed during the financial crisis primarily due to the performance of its primary source of business: single-family home residential lending. Although lending across all business lines slowed close to failure, the bank continued to manage this construction portfolio until the end of its life. After the bank failed, the FDIC placed it into receivership and collected the data. The banking data were made available to the authors under certain provisions, such as keeping the identity of the bank and customers confidential. The data consist of approximately ten years of transaction-level data for all construction loans in one of the bank's product lines that targeted mostly smaller builders and homeowners.

We build a daily loan-level dataset using events in the lending system, with multiple updates on some days and no updates on others. At origination, the bank collected the identity of the borrower and contractor, the loan terms, and the loan origination characteristics. Each day, we observe the state of the loans as the bank would have recorded them. For variables that are not updated on a daily basis, we can calculate the loan's balance and carry forward previous states and update them as information changes. For example, although a borrower's credit score may vary over time, the bank only records the borrower's credit score at the time of origination, since this is the data that was analyzed by the bank to originate the loan. A unique strength of analyzing a large construction portfolio over the course of ten years is that we can observe repeat interactions between the bank and borrowers and the bank and contractors. Furthermore, we can control for granular time-trends.

We define our variables of interest in Table 1 and present summary statistics in Table 2. The full dataset contains approximately 11.59 million loan-day observations for 28,939 loans. At origination, the average loan has a principal balance (LOANAMT) of nearly \$450,000 and a term to maturity (TERM) of 13.68 months, an interest rate that is 3.69 percent over the effective federal funds rate at origination (ORIGSPREAD), and origination fees (FEES) of 0.2 percent of the original loan amount. The value of the loan(s) on the property to the value of the completed project (CLTV), averages 75.36 percent. Figures 2a, 2b, and 2c demonstrate the distribution of the project's CLTV (percentage), original loan amount (in thousands), and loan term (in months) respectively. Over a quarter of our sample loans have loan terms that are exactly 12 months.

The average loan was given to a borrower with a 712.5 credit score (FICO). We also define several indicator variables that describe the bank's documentation for the borrower or project. This bank had a special program specifically marketed to borrowers who wanted to build their own homes but did not necessarily have construction experience, and 46 percent of loans fell into this category (OWNERBUILDER =1). Several loans in the sample were given to repeat borrowers or contractors. Approximately 4 percent of loans in our sample are given to borrowers who had previously been granted a construction loan with the bank (REPEATBORROWER =

1), and 6 percent to a repeat contractor (REPEATCONTRACTOR = 1). Borrowers and contractors are often not the same entity, so although correlated, these samples do not have perfect overlap.

The bank also collected several items that are unique to construction projects, as opposed to completed commercial buildings or single-family homes. Residential construction loans can be made with prearranged permanent funding on a speculative basis, where homes are built to be sold later in the general market. Due to their risky nature, banks typically set a predetermined limit on the number of unsold units to be financed at any time. This policy alleviates moral hazard problems of contractors potentially overextending their capacity. Speculative loans make up 9 percent of our sample (SPECULATING). The bank also required borrowers to record the number of budgeted items of a given project on their application, where more items represented more complicated projects. The average project has 58.9 line items (BUDGETITEMS), and the sample standard deviation is 15.1 items.

a. Monitoring Measures

For our sample of construction loans, we observe the timing of and frequency at which banks conduct on-site inspections. Before the bank approves a draw request, the site is often inspected. A third party typically conducts these on the construction site, and the primary purpose of the inspection is to document the project's progress. Inspectors check for accuracy of the draw request, assess the condition of the job site, and evaluate the project's stage of completion. The inspector sometimes photographs the property and delivers a comprehensive report to the lender. Nearly all sample loans have regular on-site inspections, and we construct several variables to measure their frequency. For each loan, we construct an indicator variable INSPECTIONDATE that takes a value of one on the days that on-site inspections occur. As shown by Table 2 Panel A, inspections occurred on approximately 2 percent of sample loan-days.

For each loan in the sample, we count the total number of inspections over the lifetime of the loan, ALLINSPECTIONS, and account for skewness by using the log transformation,

LOG(ALLINSPECTIONS), for our primary analysis. We also include a variable equal to the percentage of all days that the loan was active on which an inspection occurred, ALLTOTERMINAL, to capture the frequency of inspections. Finally, we calculate the time from origination until the bank’s first inspection on the loan (TIMETOFIRST). Since we calculate each of these variables once per loan, their summary statistics are shown in Table 2 Panel B. The average loan in our sample has 8.15 inspections, and the first inspection occurs 3.01 months after the origination date; on average, inspections occur on 2.31 percent of days on which a loan is active. In Figures 2d and 2e, we show the distributions of inspections and draws over the loans in our sample. Although the shape of the draw and inspection densities appear similar, as previously stated, not all draws are associated with on-site inspections, and there are fewer inspections than draws. In Figure 2f, we plot the density of the time until the first on-site inspection (in months). In Figures 3a and 3b, we show the average number of days between draws and inspections for the full sample of loans. Since these loans can vary significantly by term to maturity and approximately 25 percent of sample loans have a term to maturity of 12 months, we show analogous figures for the subset of loans with 12-month terms to maturity in Figures 3c and 3d.

#### 4. Empirical Determinants of Monitoring

In our initial analysis, we first examine whether banks trade-off monitoring intensity with observable loan characteristics within the following loan-level regression framework shown in Equation 1:

$$Monitoring_l = \gamma_1 Origination_l + \beta X_l + \epsilon_l \quad (1)$$

The dependent variable represents the cross-sectional monitoring measures of interest, which include the logarithm of the total number of on-site inspections (LOG(ALLINSPECTIONS)), the percentage of days on which inspections occur (ALLTOTERMINAL; a measure of monitoring frequency), and the time between loan origination and the first inspection (TIMETOFIRST). To isolate the conditional correlation between monitoring and origination characteristics, we include a variety of fixed effects,  $X_l$ , to control for unobservable time and macroeconomic conditions at



the time of origination. We control for intertemporal variation in monitoring incentives by including fixed effects for each loan origination day, along with the three-digit zip code<sup>3</sup> associated with the borrower and the three-digit zip code associated with the property addresses to control for localized economic conditions.<sup>4</sup> We report our baseline specifications in Table 3. If the private information collected through monitoring is more valuable to banks, we would expect both a higher number of inspections in total (LOG(INSPECTIONS)) and a higher frequency of inspections (ALLTOTERMINAL), which are reported in Columns 1 and 2, respectively. Under the same motives, banks may also choose to collect this valuable information sooner, as indicated by lower values of TIMETOFIRST in Column 3.

a. Loan Characteristics at Origination

The first four rows of Table 3 indicate significant associations between monitoring intensity and the four loan characteristics at loan origination: loan amount, term, spread, and fees. As seen in Table 3 Columns 1 and 2, there is a positive coefficient on LOG(LOANAMT), indicating that larger loans are monitored more and more often. The first two columns also indicate that lower interest rate spreads at origination and lower fees are significantly associated with more monitoring.

We also find that longer term loans are subject to less intense monitoring. The coefficient on TERM in Column 1 of Table 3 is positive, but this likely reflects a mechanical result—loans with longer terms mechanically have a longer time period over which inspections can be conducted. In Column 2 of Table 3, however, the dependent variable is the number of inspections normalized by the number of days the loan is open. The coefficient on TERM is negative, which indicates that longer term loans are subject to less frequent inspections. These results are consistent with theoretical models showing that banks derive more value from

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<sup>3</sup> Three-digit zip codes are geographic areas defined by the first three digits of postal codes (i.e., the union of all zip codes sharing the same three first digits). As such, they are larger areas than those defined by five-digit zip codes.

<sup>4</sup> We are unable to include loan fixed effects in this cross-sectional analysis because loan origination characteristics are fixed at the loan-level and would be subsumed by loan fixed effects. In unreported robustness, we replace the property zip code, borrower zip code, and day fixed with a quarter-property zipcode fixed effect, and the results are generally unchanged.

monitoring shorter term loans (Rajan and Winton, 1995; Barclay and Smith, 1995; and Park, 2000).

In Table 3 Column 3, we examine the amount of time until the first inspection. If banks find the information gained from monitoring more valuable, they may be more likely to initiate the first on-site inspection sooner. For example, in addition to monitoring a risky project *more frequently*, the bank may initiate site inspections *sooner*. If this conjecture is true, we may expect the signs on the loan origination coefficients in Column 3 to be opposite those in Columns 1 and 2. Although the average loan term in our sample is 13.68 months, the first site inspection occurs 3.01 months after origination on average. Consistent with this conjecture, we find that most types of loan origination characteristics that are associated with more (less) frequent inspections are associated with faster (slower) initial inspections, including loans with longer terms to maturity. The results in Table 3 suggest that banks trade off many types of loan terms with monitoring intensity, including the speed of on-site inspection initiations.

#### b. Borrower and Project Risk

When underwriting a loan, banks use all of the information available to them to estimate the risk associated with the borrower and project. Although hard measures of borrower quality such as FICO score may inform the bank about the credit risk of the borrower at the underwriting stage, the bank also documented a number of soft measures of borrower and project risk. If a bank suspects that a borrower will be unable to pay its debt, it may monitor more intensely in attempt to prevent the loan from defaulting, consistent with Pennacchi (1988). In Table 3, we examine the two primary hard underwriting criteria designed to capture borrower and project risk, borrower FICO scores and loan CLTV.

Within the panel setting displayed in Columns 1 and 2, we first show that borrowers and projects with higher risk characteristics (lower FICO scores and higher CLTV ratings) experience more monitoring. For FICO scores, the results of column 3 are also consistent with our expectation: riskier loans receive their first inspection sooner.

The bank categorized a subset of loans (9 percent of sample loans) as “speculative,” indicating that the homes were built to be sold later in the general market, as opposed to being pre-sold to a specific buyer. As discussed in Section 3, banks often cap the number of speculative construction loans that they originate because of their risky nature. Furthermore, banks gave 46 percent of loans to borrowers taking part in the special program marketed to owner-builders who may not have much construction experience, which may be another indication of a high-risk loan. We also examine whether banks monitored more complicated projects, as proxied by the number of budget items, more intensely. In Table 3, we find that all three measures of potential risk, as indicated by these soft information measures, positively correlate with all measures of monitoring intensity. Speculative loans (SPECULATING) are first inspected sooner than other loans, by an amount equal to 28.10 percent ( $=0.846/3.01$ ) of the full sample average time to first inspection, and borrowers who participated in the special program to build their own home (OWNERBUILDER) received their first on-site inspection 9.5 percent ( $=0.286/3.01$ ) sooner than the full sample average. Furthermore, more complicated projects, as indicated by more budget items, are inspected more frequently. These results show that the bank monitored riskier loans more, potentially because the information it was extracting on these loans was valuable and the bank was attempting to prevent loan default.

#### c. Borrower and Contractor Relationships

In our sample, we see a significant number of borrowers and construction firms conducting repeat business with the bank. We mark a repeat borrower or contractor at the time of the origination of their second loan. Existing theoretical models suggest that the information frictions caused by adverse selection and moral hazard can be mitigated in the presence of a single private lender (Diamond 1984; Ramakrishnan and Thakor 1984; Fama 1985). Boot (2000) shows that these mitigation benefits can be magnified if the information garnered by banks over multiple interactions is costly to produce, proprietary to the lender, and is reusable. Although these previously mentioned papers focus on the relationship between borrowers and lenders, it is possible that the findings can be generalized to contractors within a construction

loan setting. If repeated interactions through relationships provide the bank with additional reusable information across loans, such as borrower payment and contractor completion success, this could lead to a decrease in monitoring. However, to the extent that the bank has additional exposure to the party doing the construction (contractor) and borrower, the bank may choose to monitor these loans more frequently to manage this concentration risk. We examine the association between relationships and bank monitoring in Table 4, and we continue to control for loan origination characteristics from Table 3.

Table 4 Columns 1 and 2 indicate that loans with repeat borrowers and repeat contractors have fewer and less frequent inspections. Column 3 shows that banks initiate inspections approximately one week later for repeat contractors (0.219 months) as well as for borrowers (0.197 months). Together, results suggest a novel dimension surrounding the benefits of borrower and contractor relationships: reduced monitoring.

## 5. On-Site Inspection Reports and Draws

Thus far, our analysis has focused on time-invariant determinants of on-site inspection frequency and the time until the first inspection. A natural question to ask is how banks use the information contained within these on-site inspection reports. As discussed in Section 2b, draw schedules are determined at the time of the loan origination. After assessing whether borrowers have made adequate project progress, banks can approve or deny draw requests. Although draw requests are often associated with on-site inspections, the inspections do not occur for each draw request.

Using the text from the on-site inspection reports, we follow the textual analysis procedure outlined in Loughran and McDonald (2011) to calculate the number of words in these reports that are positive (POSITIVEWORDS) and negative (NEGATIVEWORDS) divided by total comment length in characters. We also include the comment length as measured in number of characters contained in each report. Using a panel framework, we match these on-site inspection reports to their associated draws. We present our framework in Equation 2.

$$DrawDenied_{dtl} = \gamma_1 TextMeasure_{dtl} + \beta X_t + \beta Z_l + \epsilon_{dtl} \quad (2)$$

Within Equation 2,  $DrawDenied_{dlt}$  is an indicator variable that takes a value of one if a draw request  $d$  made at time  $t$  for loan  $l$  is denied, and  $TextMeasure_{dlt}$  represents the textual sentiment measure computed from the on-site inspection report associated with the associated draw request. We can match 143,074 inspection reports to draw requests, and 13 percent of the matched draws are denied. We report the results in Table 5 with various combinations of fixed effects. Because each loan has multiple draw requests, we are also able to include loan-level fixed effects ( $Z_l$ ) in some specifications that absorb all time-invariant loan-level unobservable and observable characteristics, including those analyzed in Tables 3 and 4. Furthermore, since we observe many draws and inspections on a given day across loans, we can control for time trends by adding additional fixed effects accounting for the day of the observation ( $X_t$ ). Although inspectors are fixed at a loan level, we implement inspector-level fixed effects in place of loan-level fixed effects in Column 3 and combine inspector fixed effects with the Table 3 and 4 characteristics in Column 5. To the extent that inspectors use a time-invariant standard inspection template, the inspector fixed effect will difference out any standard language. Regardless of the fixed effects specification shown in Table 5, the results tell a consistent story. Reports with larger proportions of negative words are associated with a greater likelihood of draw denials, and reports with a larger proportion of positive words are less likely to have draw requests denied, though the total length of comments generally has no effect, with some specifications showing longer comments are associated with more denials. These results suggest that banks are actively using the information contained within these reports to determine whether to approve draw requests.

## **6. Monitoring and Loan Outcomes**

### **a. Determinants of Loan Default**

In this section, we explore the determinants of construction loan default before we attempt to quantify any additional effect monitoring has on loan outcomes. We are the first paper in the literature to conduct such an analysis, primarily due to the lack of data available to other researchers. Using a cross-sectional regression framework, we explore how the loan origination

characteristics, borrower and project risk, borrower and contractor relationships, and borrower actions affect loan default using the regression framework shown in Equation 3:

$$EVENTUALDEFAULT_l = \gamma_1 Variable_l + \beta X_l + \epsilon_l \quad (3)$$

We present full sample regression results in Table 6, where the outcome variable of interest, *EVENTUALDEFAULT*, is an indicator variable taking a value of one for loans that end in default. The results presented in Table 6 indicate that loans with longer maturities and greater fees are more likely to default, though larger loans are less likely to default. Loans to lower quality borrowers, such as borrowers with lower credit scores, are more likely to default. Riskier projects, including those with higher CLTV ratios and those categorized as speculative are more likely to default, though the coefficient on *SPECULATING* is not statistically significant. Projects with more budget items are more likely to default. Loans made to owners building their own homes are less likely to default, potentially because owners have the intent to occupy their dream home.

#### b. Marginal Effects of Monitoring

Since monitoring can be costly for the bank, it will only conduct an on-site inspection when it believes that the benefits of the information acquired through this inspection are greater than the incurred costs. One potential reason monitoring may benefit banks is improving loan outcomes, such as lowering the probability of default (Pennacchi, 1988). Therefore, the marginal effect of additional inspections on default risk should be negative. However, the bank may choose to monitor loans where the marginal benefit of an inspection reducing the default risk is greatest, which is likely for the loans with the highest risk; this would tend to induce a positive correlation between inspections and default risk. This is similar to the problem of identifying the effect of police on crime rates in Levitt (1997), where it is common to have high crime cities with large police forces. Further, more inspections may result in detection of more problems that would lead to default, much like increased policing may observe more crime that would otherwise go unreported. Therefore, our analysis suffers from a classic endogeneity problem, where banks may conduct property inspections of the loans that are most likely to default, and

directly examining the direct relationship between inspections and default probability will produce biased estimates. If this simultaneity problem is severe enough, it may even result in a positive relationship between inspections and default.

To resolve this problem in an instrumental variable setting, we require an instrument to be correlated with the number of inspections performed, yet it cannot be correlated with the default probability conditional on our set of controls. To prevent borrowers from drawing down all available loan funds at once, potentially failing to produce the collateral that the project intended to create, draw schedules for the loans are set at the time of the loan origination. Banks collect information during the underwriting process to determine the loan's draw schedule conditional on the loan characteristics. Since the draw schedule is determined at the loan's origination, the best measures that the bank has for the project's risk is based on the information collected during the underwriting process. Within our regression framework, we control for all available information garnered during the initial underwriting process, accounting for all measures of initial credit quality that might affect the scheduled number of draws.

Because borrower draw requests prompt the bank to initiate inspections before disbursing funds, draw attempts will be correlated with inspection activity. We observe the individual line drawdown requests that prompt inspections from the bank records. Simultaneously, the number of draws themselves should not be directly correlated with loan default conditional on all other observables, and because they are set ahead of time, they cannot be ex post manipulated easily by the bank or borrower. Because individual draw requests require time-consuming recordkeeping and oversight (such as phone calls), even if they do not involve on-site inspections, they are costly to the bank and to the borrower, and the bank cannot simply set an infinite or arbitrarily large number of draws.

We use a measure of draw attempts, *DRAWTOTERMINAL*, defined as the percentage of all days that the loan is active on which a draw attempt occurs. This will operate as an exogenous shifter on inspection intensity, with loans with more draws tending to have more inspections. Within the same number of draws, more inspections may be indicative of a bank's choice to conduct due

diligence on certain borrowers more intensively. The exclusion restriction is satisfied if the draw attempt frequency does not affect the default rate other than through this inspection channel, conditional on the other controls. Since we control for the broad range of project, borrower, and loan characteristics available to the bank in making the loan and setting its terms, including the draw schedule, the instrument `DRAWTOTERMINAL` is conditionally exogenous to the risk profile or default rate of the loan. Table 2 shows that when measured on the last day of the loan, on average, 2.31 percent of the days the loan was open had an inspection (`ALLTOTERMINAL`) and 3.64 percent of the days had a draw attempt (`DRAWTOTERMINAL`).

We present our analysis in Table 7. Table 7 Column 1 shows the marginal effect of more inspections (`ALLTOTERMINAL`) on default (`EVENTUALDEFAULT`) under the IV framework. A one percentage point increase in `ALLTOTERMINAL`, which can be interpreted as an increase from, say, two to three inspections in a 100-day period, would lower the probability of default by 3.63 percentage points. As the default probability is approximately 5 percent for these loans, this is a meaningful improvement in default probability.

Table 7 Column 2 shows the result of the first stage regression, regressing the inspection measure on the draw measure. The first stage has an F statistic of 11, above the rule of thumb of 10 for a weak instrument, and a positive direction as predicted by the relationship that more draws should lead to more inspections. Column 3 shows the same specification as Column 1 within an OLS framework without correcting for the endogeneity problem. Notably, the economic magnitude of the IV analysis is approximately twice the magnitude of the OLS coefficient (Columns 1 and 3), and these differences are statistically significant at the 1 percent level. This result is consistent with the prediction that OLS will underestimate the magnitude of the causal effect of inspections due to the bank's likelihood of inspecting most the projects most likely to default. Within the IV (OLS) framework, a one standard deviation increase in inspections (`ALLTOTERMINAL`) is associated with a decreased probability of default of 5.59



percentage points (2.83 percentage points).<sup>5</sup> Analogously, in the IV framework, a one standard deviation increase in inspections results in a decrease in default risk equal to about one quarter of the standard deviation of the default rate (.22, or 22 percent, being the standard deviation of EVENTUALDEFAULT from Table 2). The reduced form model presented in Column 4 shows that the relationship between greater numbers of draws and default is negative.

## 7. Additional Analysis

### a. Collateral Deteriorations

In this section, we examine whether local economic conditions affect bank monitoring decisions. Over the course of the project, local economic conditions may change. This may affect both the value of the underlying collateral as well as the probability the borrower will default. For example, borrowers may be less likely to walk away from a construction project in an area that is experiencing high levels of price appreciation since the completed project may be more valuable. However, decreasing housing prices and high foreclosure rates may depress the value of the underlying collateral or may make it more likely for borrowers to strategically default on the loan.

We construct two measures of local real estate conditions using data from FHFA and Corelogic. Our first variable, HOUSING PRICE INDEX from FHFA, calculates the annualized growth rate in prices within a five-digit zip code. The variable FORECLOSURE RATE from Corelogic measures the foreclosure rate of single-family residences in a zip code, updated monthly. The average loan is in a zip code experiencing an annualized increase in housing prices of 8.98 percent and a foreclosure rate of 0.60 percent. First, we use a framework analogous to that of Equation 2 to examine the effect changes in economic conditions have on draw outcomes.<sup>6</sup> We then implement a daily panel regression framework to test whether local

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<sup>5</sup> The impact in the IV framework of a 5.59 percentage point decline is obtained by multiplying the standard deviation of ALLTOTERMINAL (1.54, see Table 2) by the corresponding coefficient in Table 7 Column 1 (-0.0363). Similarly, OLS effect of 2.83 is obtained by multiplying 1.54 with the coefficient from Table 7 Column 3 (-0.0184).

<sup>6</sup> The analysis presented in Section 5 links on-site inspection reports to their corresponding subsample of 143,073 draw requests. Our full loan sample contains 355,890 draw requests, and not all of them are associated with on-site inspections or can be directly linked to inspector comments.

economic conditions influence the probability of the bank conducting an on-site inspection in Equation 4:

$$INSPECTIONDATE_{lt} = \gamma_1 REAL\ ESTATE\ CONDITIONS_{lt} + \beta X_{lt} + \epsilon_{lt} \quad (4)$$

Since this analysis is conducted within a panel of daily observations, we include loan fixed effects that subsume any of the origination characteristics analyzed in Tables 3 and 4. The presence of the loan fixed effects allows us essentially to compare the loan to itself during periods of relative economic growth or contraction. In Table 8, we show that increases in housing prices are associated with a decreased likelihood of a draw request being denied and the bank conducting an on-site inspection. When foreclosure rates increase, draw requests are more likely to be denied, though there is no statistically significant effect on the probability of an on-site inspection. Rajan and Winton (1995) show that collateral can be an important determinant of monitoring. To the extent that improvements in local economic conditions negatively correlate with the risk of the underlying collateral, this finding is consistent with the theoretical findings in Rajan and Winton (1995).

#### b. Monitoring During Bank Distress

Since we have daily loan-level data of approximately ten years, we can examine whether the bank changes its monitoring efforts as it approached failure.<sup>7</sup> For each loan-day, we calculate whether the bank denied a draw request (DRAWDENIED) rather than approved it and whether the bank inspected the property (INSPECTIONDATE). We define two indicator variables that take a value of one for time periods when the bank is approaching failure. The first indicator variable, YEARBEFOREFAILURE, is an indicator variable that takes a value of one on loan-days within 365 days of the bank's failure, and STARTOFYEARBEFOREFAILURE is an indicator variable equal to one if the loan-day is within the same calendar year of the bank's failure. We test whether the bank's monitoring

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<sup>7</sup> According to the FDIC Improvement Act (FDICIA), all bank failures must be resolved within 90 days of becoming critically undercapitalized. For more information on the resolution process, see the FDIC's Resolution Handbook (<https://ypfsresourcelibrary.blob.core.windows.net/fcic/YPFS/resolutions-handbook.pdf>).

efforts changed just prior to failure compared to earlier periods using the panel regression frameworks in Equations 2 and 4 and present the results in Table 9. As previously noted, the presence of the loan fixed effects allows us essentially to compare the loan to itself during periods of relative bank health and bank distress. The results in Table 9 indicate that just prior to failure, the bank is more likely to conduct inspections and more likely to deny draw requests, indicating heightened bank caution close to failure.

c. Collateral and Borrower Capital Injections

In this section, we examine whether collateral affects bank monitoring. For single-family homes and other completed structures, a creditor repossesses the collateral of the underlying home and sells it to collect payment if the borrower defaults. If value of the underlying collateral exceeds the debt that the borrower owes the bank, upon liquidation, the bank is paid in full. But, when faced with a default on a construction project, a bank faces significantly more frictions when trying to liquidate the associated assets, since the bank may only be capable of selling the incompletely assembled hard materials. Conversations with industry professionals specializing in construction loans indicate that unfinished projects are typically sold at a substantial discount.

Although it is difficult to quantify the time-varying value of collateral associated with unfinished construction projects, the bank recorded the anticipated collateral at the completion of the loan. At the time of the loan origination, the borrower and bank work together with an appraiser to produce an estimate of the value of the completed project relative to the loan amount. When pursuing a construction project, both the bank and borrower hope that the project creates value above the value of the loan. At origination, the bank records the anticipated value of this project. This variable is different from the CLTV of the project, which is the value of the loan divided by the expected value of the finished project, incorporating both expectations of appreciation and borrower contribution. The loans in our sample have an average anticipated value (VALUEADDRATIO) of 110.9 and a standard deviation of 18.8, indicating that, on average, the bank anticipated that the completed construction project would be worth approximately 110.9 percent of the loan plus posted borrower equity.

The empirical predictions associated with this measure are ambiguous. On one hand, if the value of finished product associated with these loans is expected to be relatively high, the bank may be less likely to monitor these loans because it is less likely to worry about repayment, which is consistent with the empirical results presented in Cerqueiro, Ongena, and Roszbach (2016). On the other hand, a high valuation may be indicative of naïve optimism or a hot speculative market.

In Table 10, we show that the coefficient on VALUEADDRATIO is positive and significant in Columns 1 and 2, indicating that projects with greater promise experience more and more frequent monitoring, pointing more towards the hot market and speculation motive. In contrast to our expectations discussed with respect to Table 3, a one standard deviation increase in VALUEADDRATIO is also associated with a greater time period until first inspection (Column 3). However, the average delay is less than one day at the mean ( $.00563 * 110.90 = .5944$ ), suggesting that although statistically significant, the economic magnitude of this coefficient is not meaningful.

The bank also recorded a measure of “hard costs” at the termination date of each loan. In the process of completing a project, a borrower deploys some capital to pay contractor wages, which have no liquidation value, or hard costs that have some liquidation values, such as construction materials and fixtures. Hard costs can easily exceed the loan amount if the project goes over budget. The borrower may contribute additional personal funds or attempt to secure outside funding. We define a dummy variable that takes a value of one if at the termination date, hard costs exceed the committed amount (BORROWERINPUT), which occurs for 7 percent of the sample loans. A second continuous variable quantifies the amount of hard costs that exceeds the committed loan amount (BORROWERAMT). To a certain extent, both BORROWERINPUT and BORROWERAMT represent borrower “skin in the game,” since they are deploying additional personal funds into the project. The borrower associated with the average sample loan had hard costs that exceeded the loan amount by 24.21 percent

(BORROWERAMT), and the standard deviation was 139.2 percent, indicating that a number of projects significantly exceeded costs.

The analysis in Table 10 indicates that both measures of borrower “skin in the game” are negatively correlated with on-site inspections. One possible interpretation of this is that banks monitor less when borrowers use additional personal capital (or outside funding) to fund the project because they are more personally invested in the project, potentially reflecting more closely aligned incentives between the bank and borrower. Alternatively, because these cross-sectional regressions only measure conditional correlations, it is possible that the bank’s *lax* monitoring caused the project to go over budget.

## **8. Conclusion**

A seminal body of theoretical literature asserts that a key advantage banks have over non-banks is their ability to monitor borrowers (Diamond, 1984; Fama, 1985; James, 1987; Diamond and Rajan, 2001; Kashyap, Rajan, and Stein, 2002). A growing body of theoretical models builds upon these early studies by showing the conditions under which banks have incentives to monitor and whether monitoring improves loan performance. But, primarily due to lack of data available to research, empirical scholars have struggled to test these theories.

Our proprietary, granular transaction-level data allows us to fill an important gap in the literature by testing well established theories surrounding the determinants of monitoring, understand how banks use the information garnered when monitoring, and understand the influence monitoring has on loan performance. We use a novel measure of observable monitoring: on-site inspections. To the best of our knowledge, we are the first study to test these theoretical predictions regarding monitoring frequency within a set of loans that are non-syndicated and made to individual borrowers.

Using our measure of on-site inspections, we show that lenders are more likely to trade-off monitoring with more favorable loan terms, and riskier borrowers and projects, as indicated by harder and softer information measures, have inspections that are more frequent and initiated sooner. We also show that bank lending relationships, either with the borrower or project

contractor, have a negative relationship with on-site inspections, potentially due to banks transferring information between projects. Although a large group of relationship banking studies focus on the relationships between banks and borrowers, our result suggests that contractor relationships can also be valuable in construction lending. Next, we map on-site inspection reports to draw requests. Using textual analysis, we show that on-site inspection reports that are more negative or less positive are associated with a greater likelihood of borrowers being denied draws, showing that banks use the information that they acquire from monitoring in real time.

In subsequent analysis, we provide a comprehensive analysis of the determinants of construction default, the first study of its kind, as a preamble to analyzing the incremental effect of monitoring. After implementing an instrumental variable framework and controlling for relevant determinants, we find that loans with more on-site inspections are less likely to default, suggesting that, in line with theoretical predictions, monitoring ultimately improves loan outcomes and adds value to banks.

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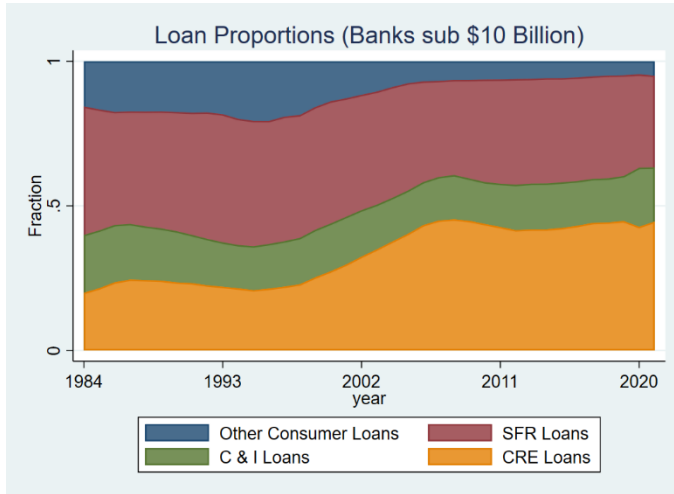
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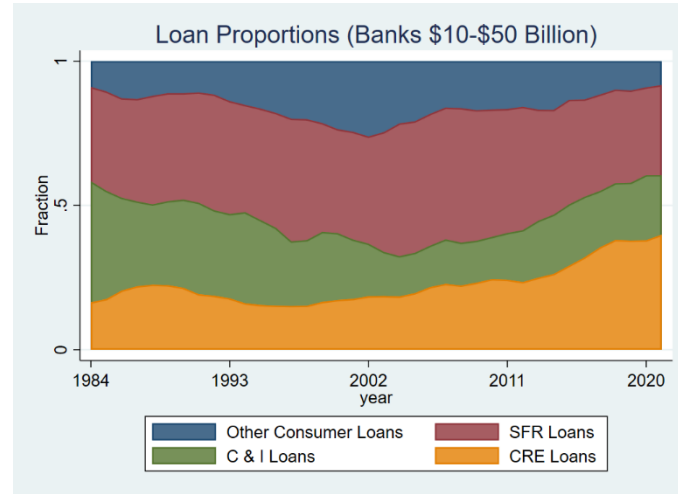
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## Tables and Figures

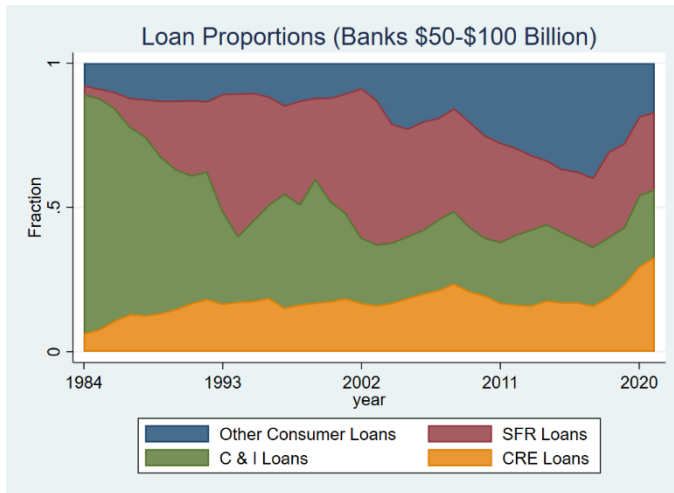
Figure 1: Bank Loan Portfolios over Time by Bank Size



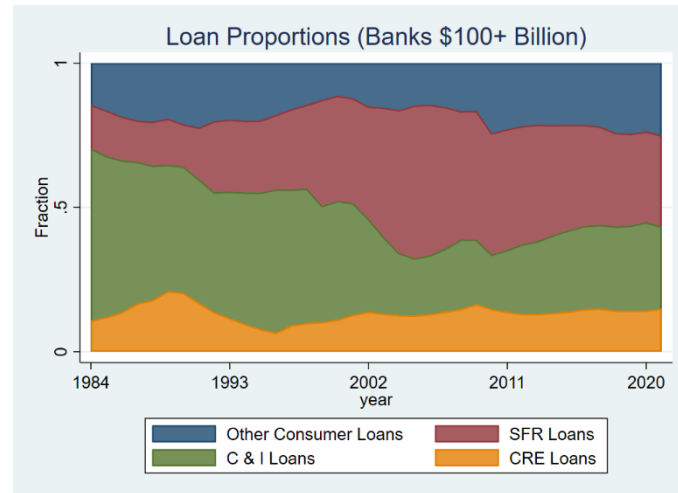
a. Banks with Assets less than \$10 billion



b. Banks with Assets between \$10 and \$50 billion

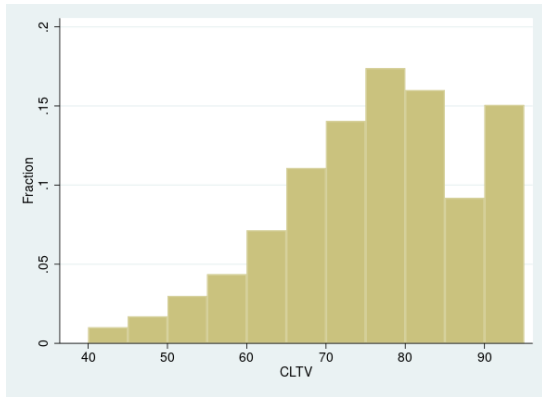


c. Banks with Assets between \$50 and \$100 billion

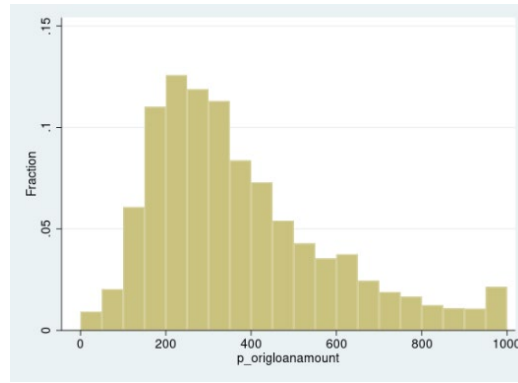


d. Banks with Assets greater than \$100 billion

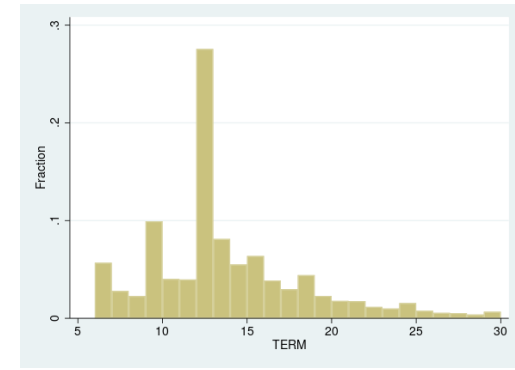
Figure 2: Loan Characteristics



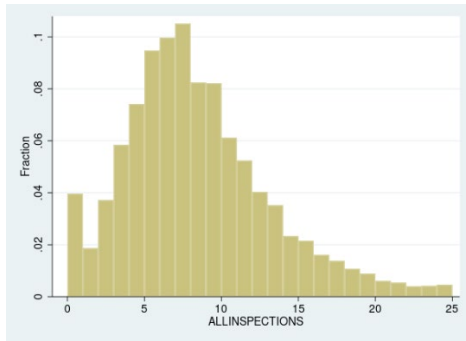
a. Combined Loan to Value of Projects (%)



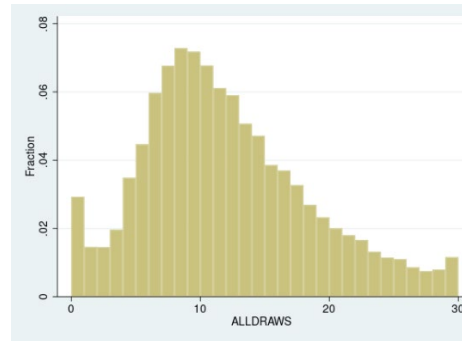
b. Original Loan Amount of Projects (Thousands)



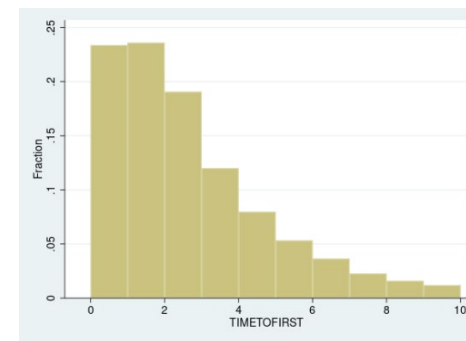
c. Loan Term (Months)



d. Lifetime Inspections of Projects (Count)

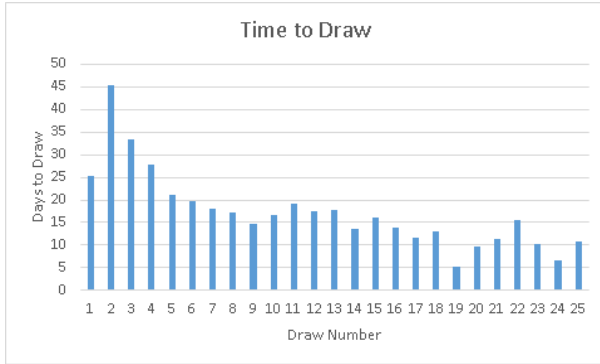


e. Lifetime Project Draws (Count)



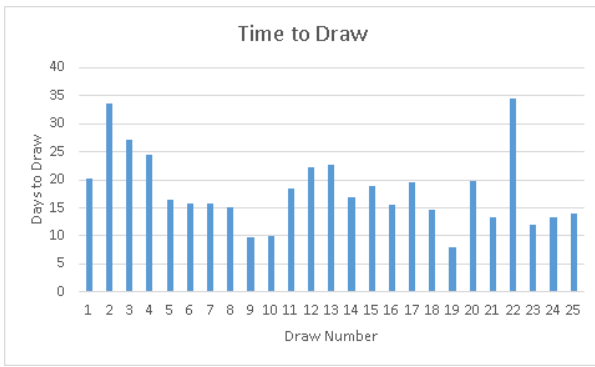
f. Time to First Inspection (Months)

Figure 3: Average Times to Draw, Inspection and Completion Rates



a. Days Between Draws (All loans)

b. Days between Inspections (All loans)



c. Days Between Draws (12 month loans)

d. Days between Inspections (12 month loans)

Table 1: Variable Definitions

Variable	Definition	Source
ALLDRAWS	is the total amount of draws over the lifetime of the loan.	FDIC
ALLINSPECTIONS	is equal to the number of inspections performed on the loan over its lifetime.	FDIC
ALLTOTERMINAL	is equal to the the percentage of all days that the loan is active on which an inspection occurs, capturing the frequency of inspections.	FDIC
BORROWERAMT	is the proportion of expenses in excess of the disbursed amount, with a project 100% over budget having a value of 100. Projects remaining under budget have a value of 0.	FDIC
BORROWERINPUT	is an indicator variable equal to one if the expenses on the project exceeded the disbursed loan amount, thus requiring the borrower to add money, and 0 otherwise.	FDIC
BORROWERZIP	is the first 3 digits of the borrower's zip code.	FDIC
BUDGETITEM	is equal to the count of line items enumerated in the plan for the structure.	FDIC
CLTV	is the value of the loan divided by the expected value of the project expressed as a percent (e.g. 100% CLTV is 100).	FDIC
COMMENTLENGTH	is the length of an inspector's comment in characters.	FDIC
DRAWDENIED	is an indicator variable equal to one if the draw that day is denied and 0 otherwise.	FDIC
DRAWSAPPROVEDTODATE	is the total number of draws that are approved over the course of the loan.	FDIC
DRAWSDENIEDTODATE	is the total number of draws that are denied over the course of the loan.	FDIC
DRAWTOTERMINAL	is equal to the percentage of all days that the loan is active on which a draw request occurs.	FDIC
EVENTUALDEFAULT	is an indicator variable that takes a value of one if the loan defaults and is 60 or more days past due.	FDIC
FEES	is the total fees paid over the first 30 days of the project divided by the original line commitment.	FDIC
FICO	is the FICO score of the individual borrower from 300 to 850.	FDIC
FORECLOSURE RATE	Monthly foreclosure rate for all housing. Original data is at the 5 digit of zip code level updated monthly	Corelogic

HARDCOSTS	is equal to the total hard costs spent on the project divided by the total loan amount disbursed by the end of the bank's record of the loan. Thus, 100 would indicate total hard costs are equal to the amount of the loan.	FDIC
HOUSING PRICE INDEX	Change in housing prices turned at an annualized rate, for all housing. Original data is at the 5 digit of zip code level from prices updated annually	FHFA
INSPECTIONDATE	is an indicator variable that takes a value of one if an inspection occurred that day and 0 otherwise.	FDIC
LOANAMT	is equal to the original loan commitment amount.	FDIC
LOG(ALLINSPECTIONS)	is equal to the natural log of the number of inspections performed on the loan over its lifetime. This variable is not calculated for loans with zero inspections, where the logarithm would be undefined.	FDIC
LOG(LOANAMT)	is equal to the natural log of the original loan commitment amount plus one dollar.	FDIC
NEGATIVEWORDS	is equal to the number of negative words, as defined by the Loughran-McDonald word sentiment dictionary, in a comment divided by its length in characters time 100. Thus, 1 is one negative word within 100 characters.	FDIC
NOTEDATE	is the year the loan note was opened or originated.	FDIC
ORIGSPREAD	is the interest rate spread at time of origination of the loan over the federal funds rate.	FDIC
OWNERBUILDER	is an indicator variable that takes a value of one if this is a loan taken by an individual looking to construct a home for them to own and live in, and 0 otherwise.	FDIC
POSITIVEWORDS	is equal to the number of positive words, as defined by the Loughran-McDonald word sentiment dictionary, in a comment divided by its length in characters times 100. Thus, 1 is one positive word within 100 characters.	FDIC
PROPERTY ZIP	is the first 3 digits of the property's zip code.	FDIC
REPEATBORROWER	is an indicator variable that takes a value of one if the borrower has had a loan with the bank before.	FDIC
REPEATCONTRACTOR	is an indicator variable that takes a value of one if the contractor has worked on a project with a loan issued by the bank before.	FDIC
SPECULATING	is an indicator variable that takes a value of one if the bank indicated the loan was speculative, meaning that the loan was	FDIC



	built without a buyer committed to purchase the property upon completion.	
STARTO FYEARBEFOREFAILURE	is an indicator variable equal to one if the loan-day is within the same calendar year of the bank's failure.	FDIC
TERM	is equal to the contractual term of the loan in months.	FDIC
TIMETO FIRST	is the number of months passing between the opening of the loan and the first inspection. This variable is not calculated for loans which were never inspected and loans where the first inspection is recorded before the loan's origination date.	FDIC
VALUEADDRATIO	is the expected value of the finished project divided by the sum of the borrower equity pledged and loan amount.	FDIC
YEAR	is the year of the loan-day being observed.	FDIC
YEARBEFOREFAILURE	Is an indicator variable equal to one if the loan-day is one year or less before the bank's failure and 0 otherwise.	FDIC

Table 2: Summary Statistics

(1) Variable	(2) N	(3) Mean	(4) SD
Panel A: Loan-Day Variables			
INSPECTIONDATE	11,585,108	0.02	0.14
COMMENTLENGTH	143,074	177.3	196.5
POSITIVETWORDS	143,074	1.40	1.47
NEGATIVETWORDS	143,074	2.33	2.11
DRAW DENIED	355,890	0.12	0.32
HOUSING PRICE INDEX	10,805,736	8.98	11.60
FORECLOSURE RATE	11,537,601	0.60	1.04
YEARBEFOREFAILURE	11,585,108	0.18	0.28
STARTOFYEARBEFOREFAILURE	11,585,108	0.08	0.39
Panel B: Loan-Level Variables			
ALLINSPECTIONS	28,939	8.15	5.17
Log(ALLINSPECTIONS)	27,803	1.97	0.62
ALLTOTERMINAL	28,939	2.31	1.54
TIMETOFIRST	27,567	3.01	2.93
EVENTUALDEFAULT	28,939	0.05	0.22
LOANAMT	28,939	448,303	416,068
LOG(LOANAMT)	28,939	12.76	0.70
ORIGSPREAD	28,939	3.69	1.12
TERM	28,939	13.68	5.62
FEES	28,939	0.20	0.66
FICO	28,939	712.50	48.62
CLTV	28,939	75.36	13.09
SPECULATING	28,939	0.09	0.28
OWNERBUILDER	28,939	0.46	0.498
BUDGETITEM	28,939	58.90	15.10
VALUEADDRATIO	28,939	110.90	18.80
BORROWERINPUT	28,939	0.07	0.25
BORROWERAMT	28,939	24.21	139.20
HARDCOSTS	28,939	91.55	146.30
REPEATCONTRACTOR	28,939	0.06	0.24
REPEATBORROWER	28,939	0.04	0.20
DRAWDENIEDTODATE	28,939	1.50	1.97
DRAWSAPPROVEDTODATE	28,939	11.03	7.33
ALLDRAWS	28,939	12.52	8.33
DRAWTOTERMINAL	28,939	3.64	2.41

Table 3: Inspections with Loan Origination Characteristics.

This table presents the ordinary least square results where the dependent variables of interest are defined as follows:  $\text{Log}(\text{ALLINSPECTIONS})$  is the logarithm of the total number of inspections over the course of the loan,  $\text{ALLTOTERMINAL}$  is defined as the ratio of total inspections to the number of days between loan origination and the loan's terminal state, and  $\text{TIMETOFIRST}$  is the number of months until the loan's first on-site inspection date. Table 1 provides further details on variable construction. T-statistics are presented in parentheses, standard errors are clustered at the loan level, and significance is denoted by \*  $p < 0.05$ , \*\*  $p < 0.01$ , and \*\*\*  $p < 0.001$ .

	(1)	(2)	(3)
	$\text{Log}(\text{ALLINSPECTIONS})$	$\text{ALLTOTERMINAL}$	$\text{TIMETOFIRST}$
$\text{LOG}(\text{LOANAMT})$	0.132*** (18.68)	0.242*** (14.92)	-0.508*** (-15.71)
$\text{ORIGSPREAD}$	-0.0126*** (-2.96)	-0.0413*** (-4.02)	0.0371* (1.91)
$\text{TERM}$	0.0182*** (24.91)	-0.0890*** (-50.77)	0.278*** (83.40)
$\text{FEES}$	-0.0113* (-1.83)	-0.0261* (-1.81)	-0.187*** (-6.60)
$\text{CLTV}$	0.00251*** (8.62)	0.00419*** (5.93)	0.0162*** (12.18)
$\text{FICO}$	-0.00163*** (-22.27)	-0.00327*** (-18.36)	0.00116*** (3.48)
$\text{SPECULATING}$	0.105*** (7.77)	0.344*** (10.37)	-0.846*** (-13.62)
$\text{OWNERBUILDER}$	0.126*** (16.52)	0.249*** (13.44)	-0.286*** (-8.20)
$\text{BUDGETITEM}$	0.00615*** (20.70)	0.0158*** (24.25)	-0.000766 (-0.56)
Property Zip Fixed Effects	YES	YES	YES
Borrower Zip Fixed Effects	YES	YES	YES
Loan Origination Day Fixed Effects	YES	YES	YES
Observations	27,803	28,939	27,567
R-squared	0.352	0.347	0.399

Table 4: Inspections with Relationship Characteristics.

This table presents the ordinary least square results where the dependent variables of interest are defined as follows:  $\text{Log}(\text{ALLINSPECTIONS})$  is the logarithm of the total number of inspections over the course of the loan,  $\text{ALLTOTERMINAL}$  is defined as the ratio of total inspections to the number of days between loan origination and the loan's terminal state, and  $\text{TIMETOFIRST}$  is the number of months until the loan's first on-site inspection date. Table 1 provides further details on variable construction. T-statistics are presented in parentheses, standard errors are clustered at the loan level, and significance is denoted by \*  $p < 0.05$ , \*\*  $p < 0.01$ , and \*\*\*  $p < 0.001$ .

	(1)	(2)	(3)
	$\text{Log}(\text{ALLINSPECTIONS})$	$\text{ALLTOTERMINAL}$	$\text{TIMETOFIRST}$
REPEATBORROWER	-0.0521*** (-2.58)	-0.0906* (-1.87)	0.219** (2.37)
REPEATCONTRACTOR	-0.0393** (-2.55)	-0.0639* (-1.70)	0.197*** (2.80)
Table 3 Controls	YES	YES	YES
Property Zip Fixed Effects	YES	YES	YES
Borrower Zip Fixed Effects	YES	YES	YES
Loan Origination Day Fixed Effects	YES	YES	YES
Observations	27,803	28,939	27,567
R-squared	0.353	0.347	0.399

Table 5: Draw Decisions Based on Inspector Comments

This table presents the ordinary least square results where the dependent variables of interest DRAWDENIED is one if the draw request is denied and zero if it is approved when compared to inspector comments. Table 1 provides further details on variable construction. T-statistics are presented in parentheses, robust standard errors are clustered at the loan-level, and significance is denoted by \*  $p < 0.05$ , \*\*  $p < 0.01$ , and \*\*\*  $p < 0.001$ .

	(1)	(2)	(3)	(4)	(5)
	DRAWDENIED	DRAWDENIED	DRAWDENIED	DRAWDENIED	DRAWDENIED
POSITIVEWORDS	-0.00181** (-2.15)	-0.00206** (-2.45)	-0.00243*** (-2.98)	-0.000913 (-0.76)	-0.000658 (-0.76)
NEGATIVEWORDS	0.00164*** (2.84)	0.00149*** (2.65)	0.00234*** (4.06)	0.00372*** (5.11)	0.00240*** (4.16)
COMMENTLENGTH	0.00000179 (0.26)	0.00000172 (0.25)	0.0000131* (1.76)	0.0000185 (1.63)	0.0000177** (2.39)
Day Fixed Effects	NO	YES	YES	YES	YES
Loan Fixed Effects	NO	NO	NO	YES	NO
Inspector Fixed Effects	NO	NO	YES	NO	YES
Table 3 and 4 Controls	YES	YES	NO	NO	YES
Observations	143,074	143,074	143,074	143,074	143,074
R-Squared	0.048	0.088	0.048	0.044	0.089

Table 6: Determinants of Default

This table presents the ordinary least square results where the dependent variable is EVENTUALDEFAULT, which is an indicator variable that takes a value of one for loans that eventually defaulted. Table 1 provides further details on variable construction. T-statistics are presented in parentheses, robust standard errors are clustered at the loan-level, and significance is denoted by \*  $p < 0.05$ , \*\*  $p < 0.01$ , and \*\*\*  $p < 0.001$ .

	(1) EVENTUALDEFAULT
LOG(LOANAMT)	-0.0396*** (-15.41)
ORIGSPREAD	0.00225 (1.38)
TERM	0.00626*** (22.54)
FEES	0.0680*** (29.92)
CLTV	0.000738*** (6.60)
FICO	-0.000276*** (-9.79)
SPECULATING	0.00735 (1.31)
OWNERBUILDER	-0.0111*** (-3.77)
BUDGETITEM	0.000421*** (4.07)
REPEATBORROWER	-0.00786 (-1.02)
REPEATCONTRACTOR	0.00886 (1.48)
Property Zip Fixed Effects	YES
Borrower Zip Fixed Effects	YES
Loan Origination Day Fixed Effects	YES
Observations	28,939
R-squared	0.251

Table 7: Instruments for Inspections to Predict Default

Column (1) shows the results of the IV estimation second stage, column (2) the first stage, column (3) OLS estimation, and column (4) the reduced form. The dependent variables of interest are EVENTUALDEFAULT, which is an indicator variable that takes a value of one for loans that eventually defaulted, and ALLTOTERMINAL, defined as the ratio of total inspections to the number of days between loan origination and the loan's terminal state. This specification uses draw schedule DRAWTOTERMINAL as an instrument. Table 1 provides further details on variable construction. T-statistics are presented in parentheses, robust standard errors are clustered at the loan-level, and significance is denoted by \*  $p < 0.05$ , \*\*  $p < 0.01$ , and \*\*\*  $p < 0.001$ .

	Draw Schedule as an Instrument			
	(1) IV Second Stage EVENTUALDEFAULT	(2) First Stage ALLTOTERMINAL	(3) OLS EVENTUALDEFAULT	(4) Reduced Form EVENTUALDEFAULT
ALLTOTERMINAL	-0.0363*** (-23.35)		-0.0184*** (-18.80)	
DRAWTOTERMINAL		0.363*** (119.62)		-0.0132*** (-22.21)
Table 3 and 4 Controls	YES	YES	YES	YES
Property Zip Fixed Effects	YES	YES	YES	YES
Borrower Zip Fixed Effects	YES	YES	YES	YES
Loan Origination Day Fixed Effects	YES	YES	YES	YES
Observations	28,939	28,939	28,939	28,939
R-squared	0.252	0.581	0.261	0.265

Table 8: Macroeconomic Variables

This table presents the ordinary least square results where the dependent variables of interest DRAWDENIED is one if the draw request is denied and zero if it is approved when a draw request occurs, and INSPECTIONDATE is equal to one if there is an inspection and zero otherwise. Table 1 provides further details on variable construction. T-statistics are presented in parentheses, robust standard errors are clustered at the loan-level, and significance is denoted by \*  $p < 0.05$ , \*\*  $p < 0.01$ , and \*\*\*  $p < 0.001$ .

	(1)	(2)	(3)	(4)	(5)	(6)
	DRAWDENIED	INSPECTIONDATE	DRAWDENIED	INSPECTIONDATE	DRAWDENIED	INSPECTIONDATE
HOUSING PRICE INDEX	-0.00201*** (-12.99)	-0.0000258** (-2.42)			-0.00135*** (-8.40)	-0.0000302*** (-2.61)
FORECLOSURE RATE			0.0322*** (11.56)	-0.0000384 (-0.44)	0.0336*** (10.62)	-0.0000962 (-1.01)
Loan Fixed Effects	YES	YES	YES	YES	YES	YES
Observations	330,594	10,805,736	354,787	11,537,601	330,594	10,805,736
R-Squared	0.001	0.000	0.001	0.000	0.002	0.000



Table 9: Bank Actions over Time

This table presents the ordinary least square results where the dependent variables of interest DRAWDENIED is one if the draw request is denied and zero if it is approved when compared to inspector comments, and INSPECTIONDATE is 1 if there is an inspection on that loan that day and 0 otherwise. Table 1 provides further details on variable construction. T-statistics are presented in parentheses, robust standard errors are clustered at the loan-level, and significance is denoted by \*  $p < 0.05$ , \*\*  $p < 0.01$ , and \*\*\*  $p < 0.001$ .

	(1)	(2)	(3)	(4)
	DRAWDENIED	INSPECTIONDATE	DRAWDENIED	INSPECTIONDATE
YEARBEFOREFAILURE	0.0767*** (20.50)	0.00241*** (8.09)		
STARTOFYEARBEFOREFAILURE			0.0920*** (21.38)	0.000803** (2.56)
Loan Fixed Effects	YES	YES	YES	YES
Observations	355,890	11,585,108	355,890	11,585,108
R-Squared	0.002	0.000	0.003	0.000

Table 10: Inspections with Borrower Characteristics

This table presents the ordinary least square results where the dependent variables of interest are defined as follows:  $\text{Log}(\text{ALLINSPECTIONS})$  is the logarithm of the total number of inspections over the course of the loan,  $\text{ALLTOTERMINAL}$  is defined as the ratio of total inspections to the number of days between loan origination and the loan's terminal state, and  $\text{TIMETOFIRST}$  is the number of months until the loan's first on-site inspection date. Table 1 provides further details on variable construction. T-statistics are presented in parentheses, standard errors are clustered at the loan level, and significance is denoted by \*  $p < 0.05$ , \*\*  $p < 0.01$ , and \*\*\*  $p < 0.001$ .

	(1)	(2)	(3)
	$\text{Log}(\text{ALLINSPECTIONS})$	$\text{ALLTOTERMINAL}$	$\text{TIMETOFIRST}$
VALUEADDRATIO	0.00411*** (18.48)	0.00760*** (14.29)	0.00563*** (5.31)
BORROWERAMT	-0.00140*** (-14.53)	-0.000881*** (-10.37)	
BORROWERINPUT	-0.617*** (-33.28)	-1.116*** (-25.82)	
Table 3 Controls	YES	YES	YES
Property Zip Fixed Effects	YES	YES	YES
Borrower Zip Fixed Effects	YES	YES	YES
Loan Origination Day Fixed Effects	YES	YES	YES
Observations	27,803	28,939	27,567
R-squared	0.412	0.394	0.399