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ABSTRACT

Using a proprietary set of transaction-level HELOC data from five banks, we explore whether banks actively manage HELOCs for periods prior to and during bank distress. Banks are more likely to revoke credit lines that exhibit potentially problematic characteristics at origination and time-varying borrower "early warning signals" of risk. In the three months before each bank's staggered failure date, when bank capital constraints and incentives to strategically deploy that capital increase, our findings grow in magnitude. In contrast, during this time, we find that, on average, borrowers do not increase HELOC drawdown rates. The existing literature focuses on how bank relationships can be valuable during periods of economic or borrower stress. To our knowledge, we are the first paper to examine the value of lending as well as deposit relationships during bank stress. Before the bank becomes distressed, we find that existing relationships have no adverse effects on banks' decision to revoke credit. As failure approaches, however, borrowers with other lending relationships are more likely to have their HELOCs cut, suggesting that lending relationships do not benefit borrowers during times of bank stress. We contribute to a growing literature that explores how contractions in the supply of credit and deteriorating bank financial health affect bank and borrower behavior.

Keywords: financial crisis, HELOC, bank run, credit monitoring, failed bank

JEL Codes: G21, G51, G01, G33

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1. Introduction

Home equity lines of credit (HELOCs), open-ended loans that allow borrowers to borrow using their properties as collateral, exploded in the run-up to the financial crisis. These loans usually have a draw period, where balances revolve for several years, and a repayment period, where the loans are amortized and repaid. Between 2003 and 2006, in parallel with the increase in single-family, first-lien, closed-end residential loans, the volume of HELOCs held on bank balance sheets nearly doubled to $1.3 trillion (Figure 1). As housing prices rose, HELOC borrowers fueled consumer spending by accessing housing equity. This study examines how banks actively managed the liquidity risk resulting from HELOC use and assesses banks' decisions to revoke select borrower HELOCs preemptively.

Commonly marketed by banks as a type of "emergency fund" alongside credit cards, HELOCs allowed borrowers to access the equity in their homes.[1] However, due their low interest rates and favorable tax treatment compared to credit cards, HELOCs quickly became a top choice for borrowers to manage their liquidity needs and smooth consumption across certain types of idiosyncratic states. While both the amount of drawn credit card and HELOC balances was approximately $300 billion in 2003, HELOC drawdowns caused balances to approximately double by 2007, while credit card draws only realized proportionally modest increases (Figure 2). As the financial markets experienced turmoil, many borrowers experienced a need for credit and drew down on their HELOCs (Figure 3). When housing prices plummeted, banks realized a

[1] In 2008, an advertisement for Indymac's "Dynamic Line," which was a home equity line of credit coupled with a physical credit card to draw on the line, touted the product as "It's my money, and I'll (action) if I want to," advocating for its use in purchase of consumer goods. For a recent example, the first product mentioned in Fidelity Bank's discussion of "emergency funds" is the Home Equity Line of Credit (HELOC). https://www.fidelitybank.com/managing-your-emergency-fund/

corresponding growth in HELOC charge-off rates, growing nearly seven-fold between 2007 and 2009 (Figure 4).

From the perspective of the bank, these committed credit agreements represented a great deal of balance sheet exposure. However, in contrast to first lien mortgages, HELOCs are usually considered "unconditionally cancellable," meaning that the bank may, at any time, with or without cause, prohibit the extension of credit, reduce the credit line, or terminate the commitment.[2] HELOC contract terms reflect the authority of banks to cancel the credit line if it concludes that borrowers will not be able to repay.[3] This ability to suspend drawdowns at will is similar to the "suspension of convertibility" studied in the literature (see, e.g., Diamond and Dybvig (1983) for bank deposits), which, in theory, should prevent run-like behaviors. The suspension of convertibility entails sub-optimal risk sharing and reputation risk to the bank. Borrowers with revoked HELOCs are unable to receive additional credit but must still repay the drawn portion.

At first glance, it may not be obvious that banks would consider borrower characteristics when rationing credit. For example, within the Diamond (1984) framework, banks holding diversified loan portfolios could maintain the same level of diversification by cutting all loans equally. However, assuming a constant demand for credit, a contraction in the supply of credit increases the cost of lending and could result in the bank cutting riskier or less profitable loans, analogous to a flight-to-quality effect modeled in Bernanke, Gertler, and Gilchrist (1996). Other studies suggest that banks may be more likely to insure borrowers with stronger relationships

[2] For further information on HELOC cancellability see Section 2 of the Regulatory Capital Rule https://www.federalreserve.gov/supervisionreg/srletters/sr1506a1.pdf

[3] For example, Regional Federal Credit Union notes that HELOCS may be suspended or reduced if "the value of your dwelling declines significantly below its appraised value" or "we reasonably believe that you will not be able to meet the repayment requirements due to a material change in your financial circumstances." See https://www.regionalfcu.org/files/regionalfcu/1/file/pdfs/predisclosure-heloc.pdf

against these shocks (Berger and Udell, 1992, 1995; Berlin and Mester, 1999; Liberti and Sturgess, 2018) because the loans are more profitable (Sharpe, 1990; Rajan, 1992; Von Thadden, 1995; Bolton, Freixas, Gambacorta, and Mistrulli, 2016) and banks are more capable of monitoring these borrowers (Holstrom and Tirole, 1997).

Despite their size and importance, HELOCs are still relatively unexplored within the academic literature, and the bulk of the existing studies focus on the determinants of borrower HELOC default. For example, Agarwal, Ambrose, Chomsisengphet, and Liu (2006) find that loans to borrowers with low credit scores and high loan-to-value (LTV) ratios at origination are more likely to default on HELOCs, and using German data, Norden and Weber (2010) find that increases in unsecured consumer credit line usage and limit violations are associated with future borrower default on individual credit lines. While HELOC contract terms give banks the ability to manage their committed credit, and existing studies identify potentially problematic loan characteristics at origination and time-varying borrower "early warning signals," it remains unknown whether banks actually use this information to manage credit lines and potentially preempt borrower default, especially when they are capital constrained just prior to failure.

The empirical work examining the unconditionally cancellable relationship between borrowers and lenders faces significant endogeneity challenges. Banks may cancel HELOCs because of borrower actions leading up to the revocation, such as heavy utilization of the available credit line, or because of events observed by the bank but not observable to the researchers, such as a borrower job loss or non-payment on other debts. We address these concerns using differences in the state corporate tax rate applicable to bank earnings, a novel source of identification in this literature. Banks in states with a higher tax rate on earnings realize larger tax savings when charging off a nonperforming loan or other bad debt, giving them

less incentive to cancel a HELOC preemptively than a bank in a lower tax state with less financial relief from a bad loan. We assume that the bank corporate tax rate affects a bank's incentives to cancel a HELOC without affecting borrower behavior.

In this study, we use a unique and granular dataset featuring detailed daily loan-level data for HELOCs. The database contains detailed borrower-level characteristics, shocks to bank financial health, and an indication of whether the bank revoked the credit line. We use FDIC-collected data from five U.S. banks, recovered shortly after their failure, with historic account-level data for each bank spanning between several months and several years prior to failure, allowing us to examine bank and borrower behavior during both times of bank solvency and months just prior to failure. Our detailed loan-level data also permit us to perform a number of cross-sectional analyses, as we observe all borrower-level and loan-level characteristics that the bank observes and at the same frequency as the bank. Our sample consists of over 85,000 geographically diverse HELOCs, and bank failure dates range from 2008 to 2011.

We find that banks are more likely to revoke credit lines for loans with high loan-to-value ratios, high interest rates at origination, or a history of delinquency. Norden and Weber (2010) suggest that credit-seeking behavior, which they define as borrower attempts to acquire credit in response to idiosyncratic stresses, could preempt default. In contrast, we find no evidence that banks manage credit lines along this dimension. In fact, banks are less likely to revoke loans with lower proportions of available credit, loans that have recently had increases in their available credit (an uncommon event), and loans where borrowers drew down over the previous month and thereby reduced the amount of credit available to them. Although banks can manage risk by cutting borrower lines to prevent them from drawing more, they cannot easily claw back already drawn balances if the money leaves the bank. Thus, it is a less effective risk mitigation strategy

for banks to cut a line that is mostly drawn, because the undrawn balance is small. We find no evidence that housing price declines are a meaningful determinant of credit line revocation.

Next, we examine whether stronger banking relationships reduce the bank's likelihood of revoking a HELOC. Although extant studies have shown that lending and non-lending relationships can be valuable during times of *borrower* distress (Berger and Udell, 1992, 1995; Berlin and Mester, 1999; Boot, Greenbaum, and Thakor, 1993; Liberti and Sturgess, 2018), to the best of our knowledge, no study examines the impact of relationships during times of *bank* distress. We find no evidence that borrowers holding deposit accounts or other loans are more likely to have their HELOCs revoked outside of failure. However, just prior to failure, banks are more likely to revoke lines of credit for borrowers with other loans, suggesting a potential dark side to lending relationships.

In subsequent tests, we analyze how banks ration borrower credit during the time just prior to bank failure. A bank is classified as critically undercapitalized once its tangible equity falls below the regulatory minimum (2% of assets) and, by law, must be resolved within 90 days. The bank may attempt to reduce leverage and risk in the run-up to failure by cutting borrower lines of credit, consistent with Ben-David, Palvia, and Stulz (2019). If borrowers fear that they will be unable to acquire new credit once their bank fails, or that the bank may close lines to manage its capital and liquidity, they may have stronger incentives to draw down on their HELOCs. However, banks may attempt to preempt these borrower drawdowns by rationing credit more aggressively. On the other hand, banks may "gamble for resurrection" by increasing their lending and risk-taking (Freixas, Rochet, and Parigi, 2004). Thus, it is ultimately an empirical question whether banks ration borrower HELOCs as failure approaches.

Our high frequency data enables us to include both HELOC loan-level and year-month fixed effects within the regression framework, controlling for HELOC-level characteristics that do not vary with time and time trends, such as the value of the benchmark rate, at the monthly frequency. The staggered nature of these failure dates allow us to separate the effects of broader macroeconomic conditions from idiosyncratic stress related to a specific bank's failure and quantify the effect that the bank's pending failure, and associated lack of capital and liquidity management options, has on managing credit relationships. In the three months prior to each bank's failure, we find that most of our results grow in magnitude. Our results indicate that banks manage HELOCs more aggressively when they face more capital and liquidity constraints close to failure. These results are inconsistent with a story of banks gambling for resurrection, as they are tolerating less risk from their borrowers, although this could be due to either increased regulatory scrutiny or increased caution from bank management.

We also find that borrowers do not increase their drawdown rates during the time just before failure despite the elevated risk of a bank failure and a higher likelihood that the bank management will render their line of credit unavailable, consistent with Diamond and Dybvig (1983). Although a number of existing studies have found evidence of depositors running down the liability side of the bank balance sheet just prior to failure (Iyer, Puri, and Ryan, 2016; Martin, Puri, and Ufier, 2018), to our knowledge, we are the first paper to examine whether consumer borrowers will draw more on credit lines just prior to bank failure. Though certain cross-sections of borrowers increase (or decrease) their drawdown rates, we find consistent evidence that borrowers decrease their HELOC usage just prior to bank failure. This is consistent with the features of the contract (unconditionally cancellable credit lines) that would make runs impossible. Reputational risk from cutting credit lines might deter bank management

from closing credit lines. This reputational risk becomes less important as the franchise value of the bank falls close to failure.

Our study contributes to a growing body of literature that explores how contractions in the supply of credit and deteriorating bank financial health affect both bank and borrower behavior. This paper also has implications for understanding what types of borrowers suffer the most harm when banks fail. Since we find that banks are more likely to manage loans associated with borrower-level characteristics that reflect low borrower or loan quality at origination, these borrowers may be least likely to find credit elsewhere during credit crunches. To our knowledge, we are the first paper to examine whether consumer borrowers increase their draws on credit lines, as opposed to running on deposit liabilities, just prior to failure, and this analysis has implications for understanding the welfare tradeoffs of HELOCs Although HELOCs may be useful for borrower consumption smoothing across certain kinds of idiosyncratic states, such as the need for home repairs, our results suggest that HELOCs do not help borrowers' smooth consumption across macroeconomic states when faced with idiosyncratic bank risk.

2. Related Literature

Our paper most directly contributes to a group of studies examining the conditions that cause banks to manage credit lines. Sufi (2009) finds that banks revoking credit lines following negative profitability shocks can incentivize firms to limit their liquidity risk optimally. Acharya, Almeida, Ippolito, and Perez-Orive (2020) show that it can be theoretically optimal for banks to revoke lines of credit following negative profitability shocks, as it can manage firm's liquidity risk expectation and strategies, and provides incentives for the bank monitoring that can contain the illiquidity transformation problem. Empirically, they show that during the collapse of the asset-backed commercial paper (ABCP) market, banks with higher exposure to ABCP

conduits negotiated significantly tougher conditions, such as higher loan rates and fees, on the outstanding credit lines offered to borrowers in violation of a covenant. Each of these papers focuses on bank credit line management for corporate borrowers, and to the best of our knowledge, we are the first study to examine credit line management within the consumer market. Given the overall size of bank balance sheet exposure to HELOCs during the financial crisis and their importance to consumers in managing downside risk, it is especially important to understand the implications supply-shocks to banks have on consumer borrowing during crisis times.

Our paper is also related to an empirical literature documenting that deterioration in the financial health of banks affects bank-dependent borrowers through a contraction in credit supply (Kashyap and Stein, 2000; Peek and Rosengren, 2000; Ashcraft, 2006; Khwaja and Mian, 2008; Paravisini, 2008; Jiménez, Ongena, Peydró and Saurina, 2012; Liberti and Sturgess, 2018). In these situations, banks facing liquidity and/or capital constraints should become stricter in their allocation of credit. The literature finds that banks ration credit for the same reasons under and not under distress, but are more sensitive to those factors when under constraints. Our findings that banks are more aggressive in closing HELOCs when subject to liquidity and capital constraints as a result of being close to failure shows that these basic results also apply to the consumer side of the credit markets.

Furthermore, our study builds on other studies examining the determinants of borrower credit line default. Agarwal, Ambrose, Chomsisengphet, and Liu (2006) show that lower borrower FICO scores, higher loan-to-value ratios, and higher unemployment rates are positively (negatively) related to HELOC default (pre-payment). In a sample of German bank borrowers with both a savings account and checking account, Norden and Weber (2010) document

increases in credit line usage, limit violations, and drawdown rates approximately 12 months before credit line default events. Jiménez, Lopez, and Saurina (2009) analyze data from Spain over 1984-2005 to investigate the determinants of corporate credit line usage and the resulting implications for estimating exposure at default. They show that the risk profile of the borrower, characteristics of the bank, and characteristics of the business cycle all impact annual credit line usage. Our study builds on this important work by analyzing whether banks use this information to revoke credit lines before potential defaults.

Finally, our study contributes to a small body of literature on the conditions under which borrowers run or draw down on their credit lines. While Kashyap, Rajan, and Stein (2002) emphasize that both deposits and credit lines are subject to runs, existing empirical studies have found only limited evidence of corporate borrower runs during the financial crisis. Our findings and setting indicate that the nature of the credit contract may play a major role in realized behavior. The contracts in Kashyap, Rajan, and Stein (2002) are strong bank commitments to borrowers to lend with limited bank recourse, making them behave closer to demand deposits. Ippolito, Peydró, Polo, and Sette (2016) use Italian credit registry data and exploit the dry-up of the European interbank market in August 2007. They find that corporate credit line drawdowns are not more pronounced at banks with more exposure to the interbank market, but firms with multiple credit lines draw preferentially down on the lines provided by banks more exposed to the interbank shock. Ivashina and Scharfstein (2010) show that after the failure of Lehman Brothers, banks that co-syndicated credit lines with Lehman were more likely to experience larger credit-line drawdowns. Both Ippolito, Peydró, Polo, and Sette (2016) and Ivashina and Scharfstein (2010) describe settings with weaker contracts, where the bank has more ability to end contracts early, and borrower actions are more motivated by a desire to draw before the bank

cancels access to many borrowers. Our setting should more closely resemble these weaker borrower commitments, and thus overall draws should not be higher under stress, but only vary for certain groups. Acharya and Steffen (2021) show that during the COVID crisis, firms drew down almost 75% of the total capacity of their credit lines, and Kapan and Minoiu (2021) show that banks with higher risk of drawdowns tightened loan supply and the terms on new loans, especially to small firms. In contrast to these studies focusing on corporate borrowers and syndicated loans, we analyze whether consumers draw down on their lines of credit before banks fail, as the failure may potentially impede consumer's ability to acquire future credit.

3. Data

We use data collected by the FDIC from bank servicing systems during the resolution process for failed banks. The foundation of our analysis is transaction-level HELOC data which we then link to term loans, non-HELOC lines of credit, and deposits to construct daily balances, interest rates, line amounts, and linkages for each line of credit to other products. We collapse our data to the monthly level, retaining one observation of each HELOC-month. These data come from five banks, spanning anywhere from months to years prior to failure, with banks failing at various points throughout the 2008-2013 financial crisis. These banks had various primary lines of business and strategies, but like many banks that failed during that period, most invested materially in loans backed by residential real estate. Although all these banks ultimately failed, we can observe borrower and bank behavior both during periods of bank solvency and in the months immediately prior to failure, and in varying bank-specific and economy-wide conditions. Our final sample consists of 1,244,156 HELOC-months spanning 87,698 HELOCs, with both banks and credit lines spread geographically throughout the country.

Dependent Variables. Two of the primary goals of this study are to understand the determinants of bank HELOC management, including during the time just prior to failure when banks are most likely to be capital constrained, and whether borrowers draw down their HELOCs in the time just prior to failure. Accordingly, our two primary dependent variables identify instances when the banks revoked the credit line and whether the borrowers drew down on the HELOC prior to failure. To isolate closures plausibly motivated by bank line management, we keep loans where the line was closed, revoked, or cut to a limit of zero dollars, as identified by the bank and servicer systems. Although it is possible for a bank to reduce the amount of credit available to borrowers through their HELOCs incrementally, we find very little evidence of this occurring within our dataset. Instead, we find that banks tend to revoke these lines entirely. To limit the possibility of consumer-initiated management, such as a refinance or sale that closed the line, we omit line cuts where the balance is zero at time of the bank closing and the balance was non-zero 31 days before closing from our regressions. This usage pattern is consistent with a consumer paying off and then eliminating a HELOC.[4] Similarly, we omit line cuts in the quarter before and after the end of the draw period of the HELOC (five or ten years) when it transitions to the loan repayment phase, as this closure is how some systems mark the pre-determined loan transition. The variable *Line Cut* represents plausibly bank-initiated HELOC revocations and takes a value of 100 in the first month where the HELOC is marked as closed or has a credit limit of 0 after having a positive credit limit on the previous month.[5] After a HELOC is revoked, we drop all further observations on the loan from the panel.

[4] This leaves open the possibility of zero-balance HELOCs being closed as part of a refinance process, which would look identical to a bank closing a zero-balance loan.

[5] We maintain all HELOCs that have buyer-initiated closures (as identified by the above metrics based on zero closing balance and a positive balance one month before close), such as sales of the underlying real estate or refinances (indicating that usage was nonzero in the month prior) in our sample for baseline comparisons as untreated observations, described in the variable *Line Cut or Closed*. We omit the days that actually have the cut, since they are not manifestations of active bank line management, but retain all other days.

The variable *Used Proportion Change Past Month* is the difference between the proportion of the credit line drawn in the previous month and the proportion drawn in the current month. A fully drawn line in the current month that was undrawn in the previous month has a *Used Proportion Change Past Month* equal to 100. The Federal Deposit Insurance Act (FDICIA) mandates that failed banks be resolved within 90 days of becoming critically undercapitalized. Because of Call Report timing and Call Report amendments, this 90-day period may not be an exact match for when public information about a bank's financial distress becomes available, but it is a good approximation that can be broadly applied across banks. As a result, we define *Close to Fail* to be an indicator variable that equal to 1 for all loans in the three months prior to the bank's failure date.

Loan-Level Characteristics. We construct both time-invariant and time-varying loan-level characteristics, with all specifications including year-month fixed effects to capture economic conditions. Our time-invariant characteristics include borrower FICO score at time of origination (*Credit Score*) and the ratio of the loan to the value of its collateral (*LTV*). Although a borrower's FICO score may change over time, the banks in our sample reporting this variable only retained its value from the time of loan origination. Banks split HELOCs into draw and repayment periods, and our outcome variables of interest cover to the end of the draw phase. Furthermore, at origination, HELOC interest rates are typically a function of a benchmark, such as the Wall Street Journal prime rate, and a positive spread. We calculate the interest rate spread at origination, *Origination Spread*, by taking the difference between the interest rate that the bank charged the borrowers on the first day of the HELOC approval and the effective federal funds rate on that day. The interest rates that banks offer borrowers should reflect the borrower's total risk, as reflected in both hard information, such as *FICO* and *LTV*, but also soft information

that the bank has about the borrower, such as the borrower's employer or business, and any discretionary changes that may occur over time. We record the variables *LTV* and *Origination Spread* as percentages, with a 5% interest rate or 100% loan-to-value ratio expressed as 5 and 100.

For each month a HELOC appears in our sample, we calculate several time-varying variables that capture "early warning signals" to banks or indications of borrowers likely seeking credit. For each day, we create two indicator variables related to delinquency. *Recent Delinquency* takes a value of 1 for loans currently more than 60 days past due and became so within the past two months. *Historic Delinquency* takes a value of 1 for loans that were more than 60 days past due at some point more than two months in the past. We also quantify the proportion of the line in use one month ago (*Used Proportion Past Month*) and whether the borrower had a line increase in the time between the loan origination and the previous month (*Previous Line Increase*). The variables *Deposit Account* and *Other Loan* each respectively takes a value of 1 if the HELOC borrower has a deposit account or other loan with the bank in that month.[6]

We present summary statistics for the 1,244,156 HELOC-months in our sample in Table 1A. Missing values arise because not all banks retained the necessary information to compute all variables. Table 1B shows summary statistics for a total of 87,698 loans on the final month that the loan is in the bank's system prior to failure. Table 1C reports summary values for the subset of loans in Table 1B that meet our criteria as a closure plausibly initiated by the bank, totaling 4,312 loans.

[6] Wherever possible in the data, we include closed-end, first-lien, residential mortgages recovered from servicing systems. In general, and especially immediately before the financial crisis, the originator bank making the mortgage loan, investors holding the credit risk, and servicer maintaining the loan are not necessarily coincident and can change rapidly over time, and thus linking data for these loans in particular is difficult.

Table 1 B indicates that approximately 15% of loans (13,154 loans) in our sample closed. Some of these closures were bank-initiated which we intend to study in detail, later discussed on Table 3, and others were consumer-initiated, such as with the sale of property. Table 1C shows that the HELOCs with bank-initiated closures have an average credit commitment of $75,802, with $58,878 drawn in the average HELOC-month. At origination, the average credit score for borrowers on these loans was 734, the average LTV ratio was 48%, and loan terms were nearly 10 (9.74) years with origination spreads that were 2.61% over the effective fed funds rate. Approximately 18% of borrowers with cut HELOCs have other loans at the bank and 55% have a deposit account. Delinquency is a rare event for these borrowers. Only 6% of them are currently delinquent and 8% have a historic delinquency. On the final day in the system, borrowers had drawn 39.6% of credit lines, with their utilization falling on average -0.15% over the previous month. About 2% had a line increase at least 31 days prior to the last day.

4. Empirical Design

In our first set of analyses, we explore whether banks manage borrower credit access by terminating HELOCs when the observable characteristics suggest that the loan is at a higher risk of default. Our first specification focuses on time-invariant default risk factors. Agarwal, Ambrose, Chomsisengphet, and Liu (2006) show that HELOC default is negatively related to FICO score (*Credit Score*) and positively related to the loan-to-value ratio (*LTV*). We also include *Origination Spread* as a potential early warning signal, since the spread that the bank offers the borrower should reflect the bank's overall assessment of the borrower's risk. We analyze the relationship between each of these loan-level variables and the bank's propensity to cut HELOC lines using the empirical framework in Equation 1:

$$Line\ Cut_{hbt} = \alpha_{hbt} + \beta_1 LoanChar_{hb} + \delta_t + \zeta_b + \gamma_{zy} + \epsilon_{hbt} \quad (1)$$

where *t* represents the month of the observation for HELOC h in bank b. $LoanChar_{hb}$ represents the HELOC-level variable of interest held in bank b. Since all HELOC-level variables are calculated at loan origination and therefore fixed over time, we cannot include loan-level fixed effects in this baseline specification. However, we include year-month fixed effects δ_t that capture time variation common across all banks, including the level of the benchmark rate and macroeconomic conditions, and bank-level fixed effects ζ_b, capturing time-invariant differences between banks, such as lending practices. We control for changes in the value of the underlying collateral through zipcode-year level fixed effects γ_{zy}, where zip codes are defined at the three digit level. We also include the month-over-month changes within the Zillow Price Index, which is calculated at the three-digit zipcode level, to account for any changes in the underlying property value. We cluster standard errors at the HELOC-level, allowing for arbitrary correlations across observations for a given HELOC.

We then examine the influence of time-varying covariates on the likelihood of HELOC revocation. Specifically, we test whether banks are more likely to cut lines for borrowers with high delinquency rates, borrowers holding other types of bank products, or borrowers exhibiting credit-seeking behaviors, as evidenced by increased borrower drawdown or increased line changes, using the empirical framework in Equation 2:

$$Line\ Cut_{hbt} = \alpha_{hbt} + \beta_1 Var_{hbt} + \delta_t + \nu_h + \gamma_{zy} + \epsilon_{hbt} \quad (2)$$

where *t* represents the month of the observation for HELOC h in bank b and Var_{hbt} represents the HELOC-month variable of interest. We include both year-month fixed effects and zipcode-year level fixed effects, where zipcodes are defined at the three-digit level as in Equation 1. We also include HELOC-level fixed effects, ν_h, to absorb time-invariant HELOC-

level characteristics, such as the variables measured at origination and the identity of the loan officer responsible for making the loan.

We also examine whether banks manage HELOCs differently as they approach failure and their capital position worsens. We interact our *Close to Fail* variable, indicating that the bank is less than 3 months from failure, with our time-invariant variables in Equation 3 and time-varying variables in Equation 4.[7]

$$Line\ Cut_{hbt} = \alpha_{hbt} + \beta_1 Close\ to\ Fail_{bt} + \beta_2 Close\ To\ Fail_{bt} * LoanChar_{hb} + \delta_t + \zeta_b + \gamma_{zy} + \epsilon_{hbt} \quad (3)$$

$$Line\ Cut_{hbt} = \alpha_{hbt} + \beta_1 Close\ to\ Fail_{bt} + \beta_2 Close\ To\ Fail_{bt} * Var_{hbt} + \delta_t + \nu_h + \gamma_{zy} + \epsilon_{hbt} \quad (4)$$

We also use Equations 3 and 4 to examine if borrowers have an increased likelihood of drawing down on their HELOCs prior to bank failure, which may reflect borrower uncertainty about access to future credit. In these specifications, our dependent variable of interest is *Used Proportion Change Past Month*, which we measure at the monthly frequency for each HELOC.

5. Results

a. Overall determinants of Bank HELOC Management

We first examine whether banks are more likely to revoke credit lines for loans that have higher risk profiles using HELOC-level information available to the bank at the time of loan origination. We follow Agarwal, Ambrose, Chomsisengphet, and Liu (2006) by using FICO score (*Credit Score*) and the loan-to-value ratio (*LTV*) as determinants of HELOC termination. We add the initiation spread (*Origination Spread)*, reflecting the bank's assessment of the

[7] As noted above, $LoanChar_{hb}$ does not vary over time, and so the HELOC level fixed effects in Equation 4 absorb the direct effect of these variables.

borrower's overall level of borrower risk, as a new potential predictor of a bank's decision to terminate a HELOC.

We also investigate whether banks manage HELOCs more aggressively in the three months prior to failure. As banks approach failure, as triggered by the prompt corrective action (PCA) threshold, they have both less capital and greater difficulty in acquiring capital as the risk of shareholders being wiped out by failure rises.[8] Banks may preserve their capital ratio by shrinking or at least preventing assets from growing by closing credit lines. The bank may become less willing to extend credit to certain borrowers, and because of the unconditionally cancellable contracts, the bank can easily adjust their borrowing exposure. Alternatively, banks may not adjust their credit rationing behavior due to concerns of losing future business or current income. In this section, we investigate whether banks manage their HELOCs more aggressively in the three months prior to failure using the empirical framework in Equations 3 and 4.

We examine the relationship between bank credit line revocation and loan risk factors using the empirical framework in Equation 1 and present results in Table 2. As previously discussed in Section 2.1, not all banks in our sample retain all information from loan origination, and this problem is particularly severe for *Credit Score*. We present regression results with *Credit Score* in Column 1 and without it in Column 2. We use the empirical framework in Equations 3 and 4 to explore any changes in these associations as banks approach failure and present analogous results in Columns 3 and 4.

[8] The term "critically undercapitalized" is defined by law as the lowest of five ranges for bank capitalization ratios. Banks are considered critically undercapitalized if their leverage ratio falls below 2%; nearly insolvent in book value terms. See 12 U.S.C. §1831o for more detail on PCA guidelines. For more detailed information regarding the resolution process, see the FDIC's Resolution Handbook https://ypfsresourcelibrary.blob.core.windows.net/fcic/YPFS/resolutions-handbook.pdf.

Consistent with our predictions, we find that banks are more likely to revoke HELOCs for loans that exhibit higher risk profiles at loan origination for each of the measures we examine. The coefficient on *Credit Score* is not statistically significant. While studies have suggested that credit scores matter for loan originations (Agarwal, Ambrose, Chomsisengphet, and Liu, 2006), our results suggest that they may be less important after origination. However, higher loan-to-value ratios (*LTV*) and spreads at origination (*Origination Spread*) are positively correlated with line revocation. When lending, banks set interest rates based on the overall risk profile of a borrower, considering both hard and soft information. As discussed in Section 2.1, banks typically set HELOC interest rates as a function of both a benchmark rate (such as prime) as well as a positive spread above the benchmark. The monthly fixed effects in Equation 1 absorb the monthly levels of the benchmark rate, indicating that the coefficient on *Origination Spread* should primarily reflect differences in the spread. Since we do not use HELOC fixed effects in this table, loans with higher overall interest rates could reflect correspondingly higher levels of risk. The positive coefficient on *Origination Spread* in Columns 1 and 2 indicates that banks are still more likely to revoke them, potentially because they are positively related to unobservable borrower quality.

In Columns 3 and 4, we add Close to Fail, an indicator variable that takes a value of 1 in the three months just prior to each bank's failure. In both columns, the coefficient on *Close to Fail* is negative but not statistically significant. The direct coefficients on *Credit Score*, *LTV*, and *Origination Spread* indicate that when a bank is not close to failure, it is more likely to revoke HELOCs with higher loan-to-value ratios and interest rates, while credit score has no effect. The interaction term between *Close to Fail* and *Credit Score*, *LTV*, and *Origination Spread* are consistent in sign with their direct effects and the interactions with *LTV* and

Origination Spread are statistically significant in Column 3, suggesting that banks revoke HELOCs more aggressively for HELOCs with some riskier origination characteristics just prior to failure. They are directionally consistent in Column 4.

Next, we examine whether time-varying differences in borrower payment and drawdown behavior affect how banks manage HELOCs. We implement four separate measures of time-varying changes in borrower delinquency and drawdown behavior using the framework in Equation 2 and present the results in Table 3. Equation 2 uses HELOC-level fixed effects, which subsume all bank fixed effects and account for all time-invariant characteristics of the loan, such as the address and value of the collateral and the origination characteristics presented in Table 2 Column 1. By including HELOC fixed effects, we identify the effects of borrower delinquency and credit-seeking behavior through variation within a given HELOC over time. In Table 3, we present results alternatively using bank-level and HELOC-level fixed effects.

Table 3, Column 1 indicates that banks are 5.355 percentage points more likely to cut a delinquent loan than a current loan, and 1.048 percentage points more likely to revoke a loan if it has a more distant history of delinquency. Since delinquency is a common precursor to default, the positive sign on *Recent Delinquency* is consistent with banks actively managing HELOCs in ways consistent with this early warning signal.

We also examine whether borrowers exhibiting credit-seeking behavior are more likely to have their lines revoked. Norden and Weber (2010) suggest that borrower credit-seeking behavior, such as large borrower drawdowns, precedes default in their sample of personal credit lines in Germany. However, after a drawdown, a borrower has less credit available for future drawdowns, leaving less credit for the bank to manage.

Our results indicate that banks are less likely to revoke the credit lines of borrowers that have lower usage levels as of the previous month. The consistently negative coefficient on *Used Proportion Past Month* indicates that banks are less likely to revoke credit lines if the line has a relatively smaller potential for future drawdowns. We also find that banks are less likely to revoke credit for borrowers who have drawn down a greater proportion of their balance within the previous month, since the coefficient on *Used Proportion Change Past Month* is negative and statistically significant. The negative coefficients on both *Used Proportion Past Month* and *Used Proportion Change Past Month* indicate that banks are less likely to manage credit for borrowers with less credit to draw upon. The negative coefficient on *Previous Line Increase* indicates that banks are less likely to cut credit lines of borrowers that had previously requested credit line increases. This finding may reflect a preference across banks for keeping credit lines that offer lower balance sheet exposure or for borrowers who have improved their unobservable risk factors since origination. Since losses are a function of both the probability of default and the bank exposure at default, both interpretations are consistent with banks being less likely to manage loans when expected losses are lower.

In Columns 3 and 4, we examine whether banks change the way they manage delinquent borrowers and those with greater credit availability in the time just prior to failure. When HELOC fixed effects are included in Column 3, the coefficient on *Close to Fail* is positive and significant, suggesting that banks revoke access to home equity lines in the time shortly before failure. The direct effects are highly consistent with those in Columns 1 and 2. The interaction terms for each of these variables and the *Close to Fail* indicator show that these effects grow in in the same direction as their original effects in the time just prior to failure. The result indicates that banks' credit line management decisions are more sensitive to changes in these variables in

the time just prior to failure. Thus, in the three months prior to failure, when banks are both liquidity and capital constrained, borrowers without a history of delinquency and those with less credit to manage are relatively less likely to have their credit lines revoked.

We now turn to the question of whether stronger borrower-bank relationships, as indicated by whether borrowers hold other loans or a deposit account with the bank, are associated with a decreased likelihood of banks revoking credit from HELOCs. Existing studies suggest that during the recent financial crisis, stronger banking relationships helped borrowers obtain access to credit (Sette and Gobbi, 2015; Bolton, Freixas, Gambacorta, and Mistrulli, 2016; Beck, Degryse, De Haas, and van Horen, 2018; Liberti and Surgess, 2018; Puri, Rocholl, and Steffen, 2010). Although most of these studies examine the origination or extension of new credit during crisis times, existing studies postulate that one benefit to borrowers with strong relationships is that banks may provide liquidity insurance when needed (Bolton, Freixas, Gambacorta, and Mistrulli, 2016). Although these studies suggest that banks may be more likely to support borrowers with stronger relationships when borrowers face distress, this may not be true when the bank faces distress. Existing studies show that non-lending relationships can be valuable to borrowers (Mester, Nakamura, and Renault, 2007; Liberti and Sturgess, 2018), since they allow banks to learn more about the borrower by monitoring multiple activities (Mester, Nakamura, and Renault, 2007; Liberti and Sturgess, 2018). However, in the event of a negative shock, such as the loss of a job, borrowers may draw down on multiple lines of credit or have multiple defaults, and thus the bank faces considerable risk due the concentration of lending associated with a single borrower.

In Table 4, we apply the framework in Equation 2 and examine whether HELOC closure is a function of the other products that a borrower may hold within a bank. When we include

HELOC fixed effects in Column 1, we find that borrower relationships do not influence the probability of a bank revoking a credit line. However, when bank-level fixed effects replace HELOC fixed effects in Column 2, the coefficient on *Deposit Account* is negative and significant, suggesting that the bank is less likely to revoke credit lines for these borrowers with deposit relationships. This finding suggests that holding a deposit account at a bank is correlated with other unobservable borrower characteristics that influence a bank's decision to maintain or revoke a credit line, but that the deposit account relationship does not have a direct effect on line revocation after controlling for these other characteristics. We also examine whether banks are more or less likely to revoke credit for borrowers when the value of the underlying collateral increases, as measured by the Zillow pricing index. As above in Table 3 when controlling for HELOC characteristics, we find no evidence that the value of the underlying collateral meaningfully impacts the probability of banks revoking credit lines when controlling for borrower relationship characteristics.

In Columns 3 and 4, we show that the direct effects on each of the three relationship variables are broadly consistent in sign with those in Columns 1 and 2. However, the interaction between *Close to Fail* and *Other Loan* is positive and statistically significant. This positive coefficient suggests a potential dark side to lending relationships, which is consistent with other lending relationships being harmful to borrowers as bank financial health deteriorates if banks grow concerned about possible correlated defaults across multiple lending relationships with the same borrower.

Our results use all available observations from our sample of banks, including those from times close to failure and times of normal bank operation. Additionally, the analyses presented in Tables 3 and 4 may suffer from bias due to time-varying unobservable loan characteristics that

may drive both borrower behavior and the closure of the credit line. When we examine the time period just prior to failure when banks have stronger incentives to manage HELOCs, we find that bank HELOC management is consistent along most of the dimensions explored in the full sample, yet more sensitive to changes in the studied determinants. Banks are more likely to revoke credit for HELOCs with riskier profiles, greater credit availability, and for borrowers with other lending relationships. However, while certain cross-sections of borrowers may be more or less likely to have their home equity loans revoked, we find that banks manage HELOCs more aggressively just prior to failure.

b. Borrower Drawdown Behavior Close to Bank Failure

In this section, we search for evidence that borrowers change their draw behavior just prior to bank failure. Each borrower in our sample has an established banking relationship through their HELOC, and pending bank failure may change this relationship and introduce uncertainty for the borrower, changing their draw behavior at present. Further, because banks may be managing capital more intensively and more likely to close lines, borrowers may have an incentive to draw before their line is closed or before other borrowers inspire the bank to restrict credit access, which may lead to self-reinforcing behavior of more bank tightening and more borrower draws. It is not clear ex ante if the net effect should be more draws, as the borrowers realize their conditional credit, or less draws, as the bank has power to restrict draws effectively at the cost to future profits. We study whether borrowers draw down on a HELOC using the same specifications as we use above for line revocations.

In Table 5, we investigate whether HELOC characteristics at the time of loan origination influence borrower drawdown behavior in the three months prior to failure. The dependent variable is *Used Proportion Change Past Month*, which is the difference in the dollar amount of

the HELOC drawn over the previous month as a percentage of the total HELOC borrowing limit. Higher values of *Used Proportion Change Past Month* indicate that borrowers drew down greater amounts of credit relative to their limits over the previous month. In Table 5 Column 1, the coefficient on *Close to Fail* is negative and statistically significant, indicating that on average, borrowers are *less likely* to draw down in the three months prior to bank failure. This result could reflect a survivor bias, if bank line revocations successfully target borrowers who are more likely to draw down on a HELOC. It is also consistent with borrowers being inattentive to bank-specific conditions, being wary of taking on additional debt from a bank that could quickly end up in new hands, or avoiding bank scrutiny that could result in line revocation at a time when they know the bank may be looking for signs of borrower distress.[9]

The results in Table 5 indicate that certain cross-sections of borrowers are *relatively* more likely to drawdown on their HELOCs. In the three months prior to failure, borrowers with higher credit scores are more likely to draw down, as indicated by the interaction between *Close to Fail* and *Credit Score*. However, riskier borrowers, as proxied by higher loan-to-value ratios or origination spreads, are no more likely to draw down their HELOCs as bank failure approaches. The effects of all borrower characteristics, when evaluated at the variable means, are economically small relative to the large negative effect on draws of being Close to Fail.

In Table 6, we examine the time-varying elements of borrower delinquency and credit-seeking behavior. As in Table 5, we find a negative coefficient on *Close to Fail*, and no evidence that the borrowers who were most credit rationed exhibit increased abnormal drawdowns when bank failure is imminent in our model with HELOC fixed effects. The coefficient on *Historic Delinquency*Close to Fail* is negative and statistically significant,

[9] Because we use credit score at origination, even if credit scores are harmed by a HELOC closure, we will not see reverse causation here as we do not observe the post revocation credit score.

indicating that borrowers with a history of delinquency are less likely to draw down as bank failure approaches. However, recently delinquent borrowers are no more (or less) likely to drawdown on their HELOCs in the three months prior to bank failure, possibly because banks restrict delinquent borrowers credit access without specifically revoking it. However, as indicated by the corresponding interaction terms, in the time just prior to failure, borrowers using greater amounts of their credit (high values of *Used Proportion Past Month*) are relatively more likely to increase their drawdown rates. Consistent with the results presented in Table 5, when the interaction term between *Close to Fail* and each independent variable is evaluated at its mean, the negative effect of the *Close to Fail* indicator variable is never reversed.

We also examine whether borrowers with stronger banking relationships draw down more on their HELOCs just prior to bank failure and present results in Table 7. If relationships provide borrowers with value and they anticipate that they will have difficulty acquiring outside credit post-failure, they may be more likely to draw on their existing HELOC. In Column 1, when HELOC fixed effects are included, the interaction terms between *Close to Fail* and *Deposit Account* or *Other Loan* are not statistically significant. However, when HELOC-level fixed effects are replaced with bank fixed effects in Column 2, there is some evidence that borrowers with deposit accounts may increase their drawdown rates.

Overall, our results indicate that borrowers do not increase their HELOC drawdown rates as bank failure approaches. While certain cross-sections of borrowers increase or decrease their *relative* drawdown rates, we do not find consistent evidence that borrowers are less likely to obtain outside credit, such as those with lower credit scores or riskier HELOC characteristics, or that borrowers with stronger banking relationships increase their HELOC usage just prior to bank failure. Our findings are consistent with three interpretations. First, it is possible that

borrowers are unable to anticipate bank failure and thus do not draw down on their HELOCs. Second, even if they do anticipate bank failure, they may not respond by drawing down on credit available through home equity lines. Third, banks may successfully manage borrowers by not allowing them to draw down on the credit they have available, thus preempting any HELOC drawdown, which has the most interesting implications for the literature.

This finding highlights features of the contract here that may have implications for similar settings. Kasyhap, Rajan, and Stein (2002) emphasizes the parallel between borrower runs on deposits and lines of credit, but notes the contracts in their analysis are hard to revoke. Other studies have found only limited evidence of corporate drawdowns consistent with run behavior in cross-sectional studies (Ivashina and Scharfstein, 2010; Ippolito, Peydro, Polo, and Sette, 2016) but those settings involve banks being possibly unwilling, but still able to honor credit lines, or contracts written to make runs less likely. While ex ante it may be reasonable to look for draw behavior before banks elect to turn lines off, this would be a setting very similar to deposits with the threat of suspension of convertibility in Diamond and Dybvig (1983). In such a setting, depositors do not run, and there is merely some sub-optimal risk sharing as some depositors are unable to convert their claims to cash needed for other activities. Since in our setting, banks can easily revoke credit lines, we accordingly do not see large drawdowns, with borrowers behaving similar to these depositors. In fact, as the franchise value of the bank falls and the risk of failure increases, these future costs becomes less relevant to the bank. Accordingly, the threat of revocation becomes even more credible, which would be consistent with the observation in this setting borrowers draw even less close to failure.

c. Bank Earnings Tax Rate

Throughout our analysis, we attempt to isolate HELOCs that are ended by banks rather than borrowers in order to study banks' determinants for ending the credit relationship. However, this is challenging because many features of the relationship between the borrower and creditor are unobservable to researchers. For example, borrowers may have significant income shocks that are known to the bank but unobservable in our data, and these income shocks may be correlated with determinants such as *Recent Delinquency* or *Used Proportion Change Past Month*.

In this section, we add the bank earnings tax rate as an additional determinant to our regressions to investigate whether the observed HELOC terminations result from bank or consumer actions. The bank tax rate affects the incentive for banks to cut HELOCs. In a state with a higher bank tax rate, a bank receives a larger tax benefit from charging off a bad loan and so faces weaker incentives to end a potentially failing HELOC early. However, the bank tax rate does not directly influence the behavior of HELOC borrowers.

We use the bank tax rate to test whether the line cuts captured in our dependent variable reflect bank or consumer behavior. If consumer behavior determines HELOC cancellations, then variation in the bank tax rate should be unrelated to consumer behavior and should not predict HELOC line cuts. If the banks initiate line cuts, then variation in the bank tax rate may influence the decision to cancel a HELOC. We present results in Table 8. In Column 1, we find that the bank tax rate is a statistically significant predictor of HELOC termination in our data, suggesting that bank incentives matter for line cuts under our definition. In Column 2, we show that the coefficient on the tax rate grows larger and is statistically significant at a greater level when adding other controls. We interpret these findings as evidence that bank incentives play a critical role in HELOC cancellations under the definition of line terminations in our sample.

6. Robustness

To alleviate the concern that one bank is driving the overall results presented in this paper, we rerun our analyses dropping each bank in turn. In each set of four banks, our results are both qualitatively and quantitatively unchanged. In unreported results, we also perform regression analyses including all covariates. Since we are unable to compute all covariates for each loan in the sample, as indicated by the varying sample sizes in our primary analysis, this approach is viable only in a considerably reduced sample. Nonetheless, we find that our regression results are qualitatively similar. The only notable exception is that borrowers with higher credit scores are less likely to have their lines cut. While this result is not statistically significant in our primary analysis, the coefficient is negative and significant at the 5% level when all covariates are included.

7. Conclusion

In the years before the financial crisis, bank balance sheet exposure to HELOCs rapidly expanded, and consumers actively drew down on these lines as the economy deteriorated. Our paper is the first to examine whether banks used common HELOC contract terms allowing credit revocation to manage the risks from these lines of credit. We contribute to a growing body of literature exploring how credit supply contractions and deteriorating bank financial health are associated with both bank and borrower behavior.

Using a unique set of proprietary, daily transaction-level data from five banks, we find that banks are more likely to revoke credit for loans that have riskier characteristics at loan origination and time-varying borrower "early warning signals." We show that banks are less likely to revoke HELOCs that have lower amounts of credit available. In further analysis, we

find that banks are more likely to revoke HELOCs for all borrowers in the three months prior to failure, when they are most likely to be liquidity and capital constrained, and they face stronger incentives to deploy capital strategically. This effect attenuates slightly for higher quality loans, more profitable loans, and loans with less unutilized credit.

Furthermore, to our knowledge, this is the first paper to examine whether consumer borrowers draw down lines of credit just prior to bank failure, and this analysis has implications for understanding the welfare tradeoffs of HELOCs. Although HELOCs may be useful for borrower consumption smoothing across certain kinds of idiosyncratic shocks, such as the need for home repairs, our results suggest that they do not help consumers smooth across macroeconomic states in the face of idiosyncratic bank risk.

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Appendix A: Variable Description

Variable	Full Text	Source
Close to Fail	*Close to Fail* is an indicator variable equal to 1 if the account-month observation is three months or fewer away from the failure date of the bank and 0 otherwise.	FDIC
Credit Score	*Credit Score* is a FICO score on the range of 300 to 850. As this is time invariant it is removed by loan level fixed effects unless interacted. Note we do not always have credit score status, but due to its removal from fixed effects this does not negatively affect most specifications.	FDIC
Deposit Account	*Deposit Account* is an indicator variable equal to 1 if the customer has a deposit account with the bank during the month and 0 otherwise. We can identify checking, savings, and CD accounts for most banks.	FDIC
End of Month Line	*End of Month Line* is equal to the maximum limit of the line in dollars at the end of the month.	FDIC
Historic Delinquency	*Historic Delinquency* is an indicator variable equal to 1 if the account month is after the loan has become 60 days or more past due more than two months in the past and 0 otherwise. Note this will be a regime change, as even if the loan cures it will still have been delinquent.	FDIC
Line Cut or Closed	*Line Cut or Closed* is a variable equal to 100 if the line's credit limit is cut to 0 (a 100% cut) after having a positive credit limit or is marked as closed, and 0 otherwise.	FDIC
Line Cut	*Line Cut* is a variable equal to 100 if the line's credit limit is cut to 0 (a 100% cut) after having a positive credit limit or is marked as closed, which we identify as a bank initiated closure, and 0 otherwise.	FDIC
Line Increase	*Line Increase* is an indicator variable equal to 1 if the line's credit limit was ever increased in the past and 0 otherwise	FDIC
Loan Term	*Loan Term* is equal to the term of the loan in years. As this is time invariant it is removed by loan level fixed effects unless interacted. Note we do not currently have separate draw and repayment periods in this draft.	FDIC
LTV	*LTV* is defined as the size of the loan divided by the size of the underlying collateral. As this is time invariant, it is removed by loan level fixed effects unless interacted. Note we do not always have other lien status for the property or lien order, so we rely on loan level fixed effects to correct for this. A loan that is exactly fully secured but is not over-collateralized has an LTV of 100.	FDIC
Original Balance	*Original Balance* is equal to the original drawn amount of the loan in dollars	FDIC

Original Loan Commitment Amount	*Original Loan Commitment Amount* is equal to the original maximum limit of the loan in dollars.	FDIC
Origination Spread	*Origination Spread* is defined as the interest rate spread above the federal funds rate as of the loans origination. A spread of 5% is listed as 5. As this is time invariant, it is removed by loan level fixed effects unless interacted.	FDIC
Other Loan	*Has Other Loans with Bank* is an indicator variable equal to 1 if the customer has either a term loan or other line of credit at the bank and 0 otherwise.	FDIC
Previous Line Increase	*Previous Line Increase* is an indicator variable equal to 1 if credit line increased anytime between one month in the past and the opening date of the credit line, assuming the line has been open for more than 31 days and, 0 otherwise. Several banks did not employ this management strategy.	FDIC
Rate	*Rate* is defined as the interest rate of the loan on the day measured. A rate of 5% is listed as 5.	FDIC
Recent Delinquency	*Recent Delinquency* is an indicator variable equal to 1 if the account month is after the loan has become 60 days or more past due for the first time in the past two months and 0 otherwise. Note this will be a regime change, as even if the loan cures it will still have been delinquent, although it will transition to *Historic Delinquency* over time.	FDIC
Tax Rate	*Tax Rate* is the yearly state-level corporate tax rate.	Tax Foundation
Used Proportion Change Past Month	*Used Proportion Change Past Month* is the difference between the proportion of the credit line that was already drawn at the end of the month and the proportion of the credit line that was already drawn one month in the past. This is also a left hand side variable in some specifications. A fully drawn line has a used proportion of 100.	FDIC
Used Proportion Past month	*Used Proportion Past Month* is equal to the proportion of the credit line that was already drawn one month in the past in the regressions and unlagged in the summary statistics tables. A fully drawn line has a used proportion of 100.	FDIC
Zillow Price Index Growth	Zillow Price Index Change is the change in the past month at the 3 digit zip code level of the Zillow housing price index.	FDIC

Tables and Figures

Figure 1: Size of HELOC Holdings Relative to All Mortgages for Banks using Call Report data

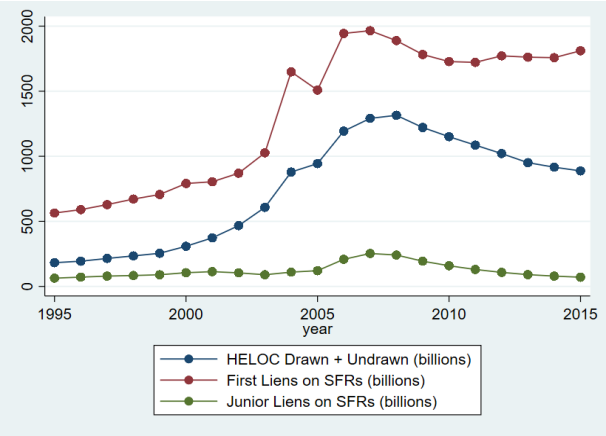


Figure 2: Size of HELOC Market Relative to Other Selected Consumer Borrowing for Banks using Call Report data

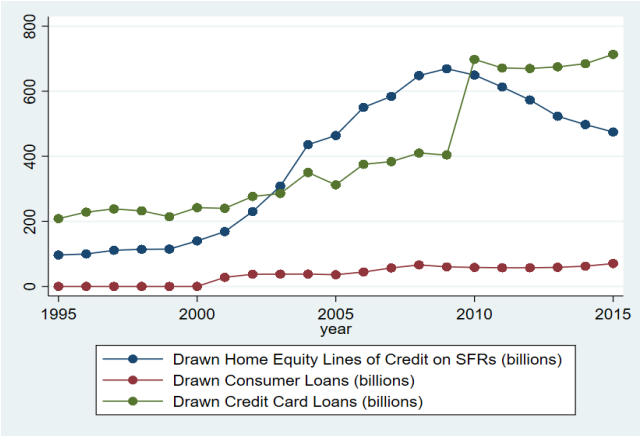


Figure 3: HELOC Draw Patterns using Call Report data

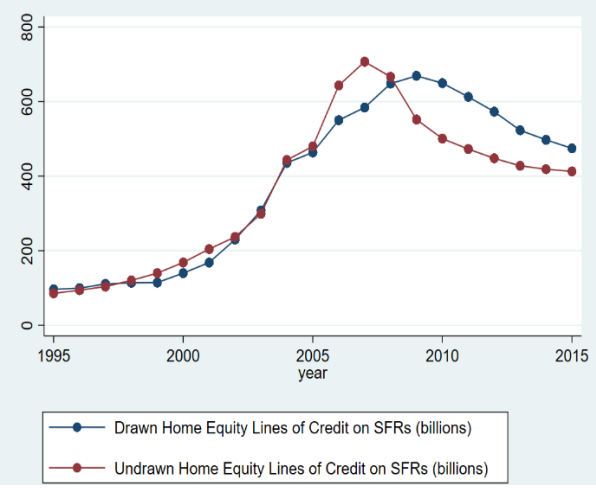
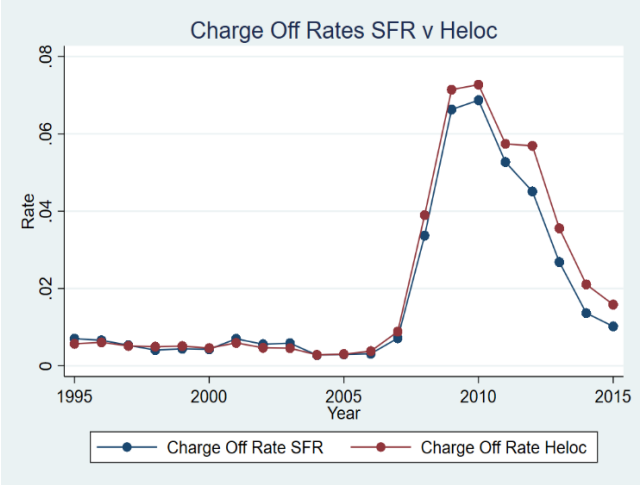


Figure 4: Charge Off Rates for SFR and HELOC using Call Report data



Source: FDIC Call Report Data

Table 1A: Loan and Borrower-Level Characteristics, All Loan-Months.

This table displays summary statistics for each month at each HELOC. All variables defined in Appendix A.

(1) Variable	(2) Mean	(3) Median	(4) SD	(5) N
Original Loan Commitment Amount	79,305.14	50,000	159,000	1,244,156
Original Balance	15,023.5	4,898	80,065.37	562,206
Line Cut or Closed	1.00	0.00	10.00	1,244,156
Credit Score	732.21	745.00	63.96	907,223
LTV	37.36	25.00	30.45	1,177,438
Loan Term	11.74	11.67	6.01	1,244,156
Origination Spread	2.4	2.59	2.02	1,186,837
End of Month Principal	45,665.79	21,981	92620	1,244,156
End of Month Line	80,794.1	50,000	161,000	1,244,156
Historic Delinquency	0.04	0.00	0.2	1,244,156
Recent Delinquency	0	0.00	0.07	1,244,156
Used Proportion Past Month	58.82	68.16	37.04	1,230,373
Used Proportion Change Past Month	0.48	0.00	9.81	1,143,104
Previous Line Increase	0.04	0.00	0.2	1,244,156
Deposit Account	0.54	1.00	0.5	1,244,156
Other Loan	0.21	0.00	0.41	1,244,156
Zillow Price Index Change	-0.35	-0.20	1.27	1,079,703
Close to Fail	0.11	0.00	0.31	1,244,156
N				1,244,156

Table 1B: Loan and Borrower-Level Characteristics, Last loan-month.

This table displays summary statistics for one observation for each HELOC on the last month it appears in the servicing system or on the month the bank failed, if it continued to be in the servicing system post failure. All variables defined in Appendix A.

(1) Variable	(2) Mean	(3) Median	(4) SD	(5) N
Original Loan Commitment Amount	87,643.85	60,000	111,000	87,698
Original Balance	13,597.96	1,966	68,904.62	12,044
Line Cut or Closed	15.0	0.00	36.0	87,698
Credit Score	716.38	723.00	67.62	76,719
LTV	44.09	48.36	28.9	83,169
Loan Term	17.33	20.00	28.9	87,698
Origination Spread	3.7	3.73	1.77	85,008
End of Month Principal	60,983.95	40,990	82,752.73	87,698
End of Month Line	88,062.36	60,000	112,000	87,698
Recent Delinquency	0.02	0.00	0.14	87,698
Historic Delinquency	0.025	0.00	0.15	87,698
Used Proportion Past Month	72.15	93.36	35.78	87,269
Used Proportion Change Past Month	-0.03	0.00	8.06	84,991
Previous Line Increase	0.01	0.00	0.12	87,698
Deposit Account	0.18	0.00	0.38	87,698
Other Loan	0.43	0.00	0.5	87,698
Zillow Price Index Growth	-1.45	-1.26	1.3	83,940
Close to Fail	0.84	1.00	0.36	87,698
N				87,698

Table 1C: Loan and Borrower-Level Characteristics, Treated Loan-Month.

This table displays summary statistics for one observation for each HELOC on the first day it appeared in the servicing system as a closed loan and met our criteria for being a bank-initiated closure, a *Line Cut*. All variables defined in Appendix A.

(1) Variable	(2) Mean	(2) Median	(3) SD	(4) N
Line Cut	100.00	100.00	0	4,312
Original Loan Commitment Amount	75,802.2	40,000	225,000	4,312
Original Balance	16,923.24	60,000	134,000	2,133
Credit Score	734.36	747.00	59.92	2,587
LTV	48.14	33.01	36.36	3,940
Loan Term	9.74	10.00	5.91	4,312
Origination Spread	2.61	2.59	1.61	4,078
End of Month Principal	23,346.14	6,428	712,64.14	4,312
End of Month Line	76,216.05	40,000	226,000	4,312
Recent Delinquency	0.06	0.00	0.24	4,312
Historic Delinquency	0.08	0.00	0.28	4,312
Used Proportion Past Month	39.6	26.00	41	4,307
Used Proportion Change Past Month	-0.15	0.00	11.82	4,303
Previous Line Increase	0.02	0.00	0.16	4,312
Deposit Account	0.55	1.00	0.5	4,312
Other Loan	0.18	0.00	0.39	4,312
Zillow Price Index Growth	-0.8	-0.54	0.93	3,885
Close to Fail	0.31	0.00	0.46	4,312
N				4,312

Table 2: Line Cuts with Loan Characteristics at Origination.

This table presents the estimates from an OLS regression where the dependent variable, *Line Cut*, is an indicator variable that takes a value of 100 on the first day of a bank-initiated closure where the bank either revoked the HELOC by either dropping the available credit limit to 0 or marking it as closed and 0 otherwise. The variable *Close to Fail* is an indicator variable that takes a value of 1 for observations within the three months prior to failure. All other variables are defined in Appendix A. Standard errors are clustered by HELOC. T-statistics are presented in parentheses, and significance is denoted by * p <0.05, ** p < 0.01, and *** p<0.001.

	(1) Line Cut	(2) Line Cut	(3) Line Cut	(4) Line Cut
Credit Score	0.0000232		0.0000457	
	(0.26)		(0.47)	
LTV	0.00461***	0.00667***	0.00409***	0.00669***
	(17.04)	(26.80)	(13.43)	(24.28)
Origination Spread	0.0199***	0.0195***	0.0163***	0.0177***
	(5.83)	(6.37)	(4.88)	(5.75)
Close to Fail			-0.253	-0.135
			(-1.06)	(-1.47)
Credit Score * Close to Fail			0.0000471	
			(0.17)	
LTV * Close to Fail			0.00266***	-0.000166
			(3.08)	(-0.20)
Origination Spread * Close to Fail			0.0245*	0.0168
			(1.79)	(1.42)
Zillow Price Index Growth	Yes	Yes	Yes	Yes
HELOC FE	No	No	No	No
Bank FE	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes
Zip 3 * Year FE	Yes	Yes	Yes	Yes
SE Clustered at Loan Level	Yes	Yes	Yes	Yes
N	734,500	959,190	734,500	959,190
R-sq	0.065	0.049	0.065	0.049

Table 3: Line Cuts with Early Warning Signals.

This table presents the estimates from an OLS regression where the dependent variable, *Line Cut*, is an indicator variable that takes a value of 100 on the first day of a bank-initiated closure where the bank either revoked the HELOC by either dropping the available credit limit to 0 or marking it as closed and 0 otherwise. The variable *Close to Fail* is an indicator variable that takes a value of 1 for observations within the three months prior to failure. All other variables are defined in Appendix A. Standard errors are clustered by HELOC. T-statistics are presented in parentheses, and significance is denoted by * p <0.05, ** p < 0.01, and *** p<0.001.

	(1) Line Cut	(2) Line Cut	(3) Line Cut	(4) Line Cut
Recent Delinquency	5.355*** (15.05)	5.122*** (15.27)	5.035*** (13.49)	4.794*** (13.67)
Historic Delinquency	1.048*** (10.87)	0.418*** (10.15)	0.975*** (9.92)	0.401*** (9.79)
Used Proportion Past Month	-0.00922*** (-20.61)	-0.00665*** (-31.44)	-0.00875*** (-19.74)	-0.00662*** (-30.80)
Previous Line Increase	-0.607*** (-8.34)	-0.101** (-2.34)	-0.510*** (-7.07)	-0.0316 (-0.71)
Used Proportion Change Past Month	-0.00368*** (-4.50)	-0.00492*** (-6.45)	-0.00319*** (-3.95)	-0.00465*** (-6.04)
Close to Fail			0.627*** (3.49)	-0.0528 (-0.44)
Recent Delinquency * Close to Fail			2.690** (2.31)	2.851** (2.48)
Historic Delinquency * Close to Fail			0.431* (1.75)	0.212 (0.91)
Used Proportion Past Month * Close to Fail			-0.00987*** (-4.95)	-0.000333 (-0.34)
Previous Line Increase * Close to Fail			-1.152*** (-8.44)	-1.030*** (-7.68)
Used Proportion Change Past Month * Close to Fail			-0.00864 (-1.03)	-0.00514 (-1.16)
Zillow Price Index Growth	0.00681 (0.56)	0.00199 (0.19)	0.00710 (0.58)	0.00219 (0.21)
HELOC FE	Yes	No	Yes	No
Bank FE	No	Yes	No	Yes
Month FE	Yes	Yes	Yes	Yes
Zip 3 * Year FE	Yes	Yes	Yes	Yes
SE Clustered at Loan Level	Yes	Yes	Yes	Yes
N	978,125	978,125	978,125	978,125
R-sq	0.049	0.049	0.050	0.049

Table 4: Line Cuts with Relationship Variables

This table presents the estimates from an OLS regression where the dependent variable, *Line Cut*, is an indicator variable that takes a value of 100 on the first day of a bank-initiated closure where the bank either revoked the HELOC by either dropping the available credit limit to 0 or marking it as closed and 0 otherwise. The variable *Close to Fail* is an indicator variable that takes a value of 1 for observations within the three months prior to failure. All other variables are defined in Appendix A. Standard errors are clustered by HELOC. T-statistics are presented in parentheses, and significance is denoted by * p <0.05, ** p < 0.01, and *** p<0.001.

	(1) Line Cut	(2) Line Cut	(3) Line Cut	(4) Line Cut
Deposit Account	-0.0768	-0.0455***	-0.0778	-0.0460***
	(-1.42)	(-3.33)	(-1.43)	(-3.51)
Other Loan	0.0388	-0.00400	0.0204	-0.0221
	(0.59)	(-0.27)	(0.31)	(-1.30)
Close to Fail			-0.155	-0.156
			(-1.26)	(-1.42)
Deposit Account * Close to Fail			0.0102	0.0407
			(0.08)	(0.36)
Other Loan * Close to Fail			0.363**	0.0803**
			(2.14)	(2.26)
Zillow Price Index Growth	0.00848	0.00676	0.00827	0.00698
	(0.74)	(0.74)	(0.72)	(0.77)
HELOC FE	Yes	No	Yes	No
Bank FE	No	Yes	No	Yes
Month FE	Yes	Yes	Yes	Yes
Zip 3 * Year FE	Yes	Yes	Yes	Yes
SE Clustered at Loan Level	Yes	Yes	Yes	Yes
N	1,071,396	1,071,396	1,071,396	1,071,396
R-sq	0.045	0.045	0.045	0.045

Table 5: Line Draws with Fixed Loan Characteristics Close to Failure.

This table presents the estimates from an OLS regression where the dependent variable is a change in the proportion of the HELOC utilized over the last month. The variable *Close to Fail* is an indicator variable that takes a value of 1 for observations within the three months prior to failure. All other variables are defined in Appendix A. Standard errors are clustered by HELOC. T-statistics are presented in parentheses, and significance is denoted by * p <0.05, ** p < 0.01, and *** p<0.001.

	(1) Used Proportion Change Past Month	(2) Used Proportion Change Past Month
Credit Score	-0.00191*** (-10.35)	
LTV	-0.00272*** (-7.32)	-0.00244*** (-7.65)
Origination Spread	0.0302*** (5.15)	0.0120** (2.45)
Close to Fail	-3.027*** (-8.38)	-0.0334 (-0.34)
Credit Score * Close to Fail	0.00416*** (8.73)	
LTV * Close to Fail	0.00149 (1.45)	0.00159 (1.63)
Origination Spread * Close to Fail	-0.0221 (-1.22)	-0.0235 (-1.56)
Zillow Price Index Growth	0.0179 (0.92)	0.0319* (1.91)
HELOC FE	No	No
Bank FE	No	Yes
Month FE	Yes	Yes
Zip 3 * Year FE	Yes	Yes
SE Clustered at Loan Level	Yes	Yes
N	666,520	885,177
R-sq	0.007	0.007

Table 6: Line Draws with Early Warning Signals Close to Failure.

This table presents the estimates from an OLS regression where the dependent variable is a change in the proportion of the HELOC utilized over the last month. The variable *Close to Fail* is an indicator variable that takes a value of 1 for observations within the three months prior to failure. All other variables are defined in Appendix A. Standard errors are clustered by HELOC. T-statistics are presented in parentheses, and significance is denoted by * p <0.05, ** p < 0.01, and *** p<0.001.

	(1) Used Proportion Change Past Month	(2) Used Proportion Change Past Month
Recent Delinquency	-0.449**	0.552***
	(-2.51)	(3.53)
Historic Delinquency	-0.0986	0.559***
	(-0.77)	(10.72)
Used Proportion Past Month	-0.156***	-0.0458***
	(-106.22)	(-92.50)
Previous Line Increase	1.953***	0.558***
	(9.44)	(6.63)
Close to Fail	-3.102***	-4.259***
	(-23.00)	(-35.31)
Recent Delinquency * Close to Fail	0.282	-0.742**
	(0.74)	(-2.17)
Historic Delinquency * Close to Fail	-0.857***	-0.921***
	(-6.84)	(-8.35)
Used Proportion Past Month * Close to Fail	0.0481***	0.0636***
	(34.47)	(56.27)
Previous Line Increase * Close to Fail	-0.342*	-0.468**
	(-1.77)	(-2.52)
Zillow Price Index Growth	0.0233	0.00856
	(1.18)	(0.54)
HELOC FE	Yes	No
Bank FE	No	Yes
Month FE	Yes	Yes
Zip 3 * Year FE	Yes	Yes
SE Clustered at Loan Level	Yes	Yes
N	1097421	1097421
R-sq	0.099	0.031

Table 7: Line Draws with Relationship Variables Close to Failure.

This table presents the estimates from an OLS regression where the dependent variable is a change in the proportion of the HELOC utilized over the last month. The variable *Close to Fail* is an indicator variable that takes a value of 1 for observations within the three months prior to failure. All other variables are defined in Appendix A. Standard errors are clustered by HELOC. T-statistics are presented in parentheses, and significance is denoted by * p <0.05, ** p < 0.01, and *** p<0.001.

	(1) Used Proportion Change Past Month	(2) Used Proportion Change Past Month
Deposit Account	0.148* (1.81)	0.108*** (5.57)
Other Loan	-0.459*** (-4.87)	0.0784*** (2.95)
Close to Fail	-0.0762 (-0.76)	-0.0918 (-0.97)
Deposit Account * Close to Fail	0.0959 (1.17)	0.120* (1.66)
Other Loan * Close to Fail	0.140 (1.20)	0.00283 (0.05)
Zillow Price Index Growth	0.0294 (1.55)	0.0185 (1.17)
HELOC FE	Yes	No
Bank FE	No	Yes
Month FE	Yes	Yes
Zip 3 * Year FE	Yes	Yes
SE Clustered at Loan Level	Yes	Yes
N	978125	978125
R-sq	0.007	0.006

Table 8: Line Cuts with Bank Corporate Earnings Tax Rate.

This table presents the estimates from an OLS regression where the dependent variable, *Line Cut*, is an indicator variable that takes a value of 100 on the first day of a bank-initiated closure where the bank either revoked the HELOC by either dropping the available credit limit to 0 or marking it as closed and 0 otherwise. The variable *Close to Fail* is an indicator variable that takes a value of 1 for observations within the three months prior to failure. All other variables are defined in Appendix A. Standard errors are clustered by state. T-statistics are presented in parentheses, and significance is denoted by * p <0.05, ** p < 0.01, and *** p<0.001.

	(1) Used Proportion Change Past Month	(2) Used Proportion Change Past Month
Tax Rate	-0.195*	-0.274**
	(-2.59)	(-3.23)
LTV		0.00619*
		(2.56)
Origination Spread		0.0187**
		(5.75)
Recent Delinquency		4.957
		(1.23)
Historic Delinquency		0.360***
		(8.88)
Used Proportion Past Month		-0.00524**
		(-3.54)
Previous Line Increase		0.00218
		(0.07)
Deposit Account		-0.0704**
		(-4.35)
Other Loan		-0.0230
		(-0.74)
Used Proportion Change Past Month		-0.00469*
		(-2.92)
Close to Fail		0.127
		(0.20)
LTV * Close to Fail		0.00941
		(0.54)
Origination Spread * Close to Fail		0.0711
		(2.10)
Recent Delinquency * Close to Fail		3.922*
		(2.56)
Historic Delinquency * Close to Fail		0.497*
		(3.10)
Used Proportion Past Month * Close to Fail		-0.00387
		(-0.83)
Previous Line Increase * Close to Fail		-0.994**
		(-4.40)
Used Proportion Change Past Month * Close		-0.00308
		(-0.63)
Deposit Account * Close to Fail		0.135
		(0.60)
Other Loan * Close to Fail		0.0183
		(0.13)
Zillow Price Index Growth		0.0413
		(1.10)
HELOC FE	No	No
Bank FE	No	No
Month FE	Yes	Yes
Zip 3	No	Yes
SE Clustered at State Level	Yes	Yes
N	1,235,144	885,177
R-sq	0.022	0.033