On Deposit Stability in Failing Banks

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Abstract

We use a novel dataset from a US bank which failed after the financial crisis of 2007-2009 to study the outflow of bank deposits in distressed institutions. Our unique data allow us to observe account-level balances at the daily frequency in all deposit accounts at the bank to help explain deposit behavior prior to the bank's failure. We find, faced with bad regulatory news specific to the bank, uninsured depositors flee the bank. We find that government deposit guarantees, both regular deposit insurance and temporary deposit insurance measures (e.g., the FDIC's Transaction Account Guarantee Program), reduce the outflow of deposits and meaningfully improve deposit stability. Consistent with assumptions in Basel III, we find checking accounts are more stable than savings accounts. We also provide evidence on run off rates in different periods and find that run off rates assumed in the Basel III Net Stable Funding Ratio may be too low, especially during periods of extreme stress. Finally, we show that this bank was able to offset losses of uninsured deposits with new insured deposits remarkably well as it approached failure. This is concerning because it undermines the depositor discipline widely considered to be one of the key pillars of financial stability, provides an opportunity for gambling for resurrection, and suggest that existing supervisory tools to constrain deposit acquisition by unhealthy banks are may not be completely effective.

Keywords: depositor withdrawals, funding stability, depositor discipline, liquidity, LCR, NSFR, bank failure

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1 Introduction

There were many bank failures during the financial crisis of 2007-2009, continuing for several years following. In this period, many systemically important institutions, as well as numerous smaller firms, faced severe liquidity stress. The stress resulted in the high-profile failure or near failure of many financial institutions and unprecedented emergency liquidity support by governments around the world. The inability of financial institutions to maintain stable funding sources was, arguably, central to the crisis. Large numbers of deposits exited from failing banks. This, in turn, prompted regulators to formulate new rules aimed at preventing a repeat of such an episode of illiquidity and funding stress.

One of the central questions for regulators during the crisis was whether to extend the scope and limits of deposit insurance in an effort to reduce deposit outflows. In the US, deposit insurance for regular accounts was increased from \$100,000 to \$250,000. Other countries, such as the UK, took similar measures. At the same time, the US government also expanded the scale and scope of deposit insurance through other programs, the most important of which was the Transaction Account Guarantee (TAG) Program, which temporarily removed the cap for deposit insurance coverage for many deposit accounts in the US around the crisis. Despite the importance attached to deposit insurance and the strong belief in its ability to enhance deposit stability in the US and internationally — there is remarkably little evidence on the effectiveness of deposit insurance in preventing deposit outflows.

Apart from examining the effectiveness of deposit insurance, it is also important to evaluate the new, post-crisis rules intended to help promote and safeguard liquidity, as these rules have a first order effect on banks and their ability to make loans while maintaining capital adequacy. However, there is little empirical evidence to help validate the correct regulatory response. Among the most high-profile of such new regulations are the Liquidity Coverage

Ratio (LCR) and Net Stable Funding Ratio (NSFR), advocated by the Basel Committee on Bank Supervision. These require that banks maintain adequate "liquidity/stability-adjusted" funding consistent with their "liquidity/stability-adjusted" assets. Such an approach clearly requires regulators and banks to take a stance on the stability of various funding sources. E.g., the Basel Committee expects that at least 3% of "stable" retail deposits will run off in a month of severe liquidity stress, while at least 10% of "less stable" retail deposits do the same. The Basel Committee encourage country-level regulators, as they implement the new rules, to consider requiring institutions under their purview to use runoff rates higher than the minimums recommended.

More generally, the financial crisis has motivated economists, regulators, and financial institutions to critically consider funding stability. Yet, there is very little empirical evidence on the stability of banks' funding sources along all of the dimensions discussed above, particularly the stability of deposits.

This paper aims to address the lack of evidence on deposit funding stability using a novel supervisory dataset for a failed bank in the US.[1] The data were collected by the FDIC from a single American bank shortly after its failure, and they allow us to measure daily, account-level attributes and balances for several years. The bank failed during the wave of bank failures following the financial crisis of 2007-2009. It had assets of roughly $2 billion around the time of the crisis and was primarily funded by deposits. Although the bank was fairly small relative to most major banks in the US, it was relatively large in comparison with other failed banks — the average failed bank in the last decade has been smaller than the average non-failed bank. Like many banks in the US, the bank we study appeared healthy prior to the crisis based on publicly available indicators, but deteriorate thereafter. Its failure was

[1]Henceforth, unless otherwise noted, we will use the term "bank" to refer to any depository institution, whether it be a commercial bank, thrift, credit union, or the like that takes insured deposits. We use the broader term "financial institution" when needed, which includes all of the institutions under the term "bank" as well as other institutions such as non-bank finance companies, insurance companies, hedge funds and other companies commonly referred to as "shadow banks."

caused largely by a heavy concentration of lending in exotic residential mortgage products, such as adjustable rate mortgages (ARMs) and option ARMs, coupled with inadequate board of directors oversight of the attendant risks.

Using these data, we shed light on the stability of deposits and assess the deposit(or) characteristics associated with less stable deposits. We provide evidence on the effectiveness of deposit insurance as well as the Transaction Account Guarantee (TAG) Program. Additionally, we estimate runoff rates comparable to those expected by the Basel Committee for the LCR and NSFR, and comment on the appropriate run rate assumptions for deposit outflow. We also document the bank's response to fleeing uninsured deposits and how the bank was able to attenuate or eliminate depositor discipline.

More specifically, we begin with a thorough historical analysis. This analysis highlights a couple of important points. First, term deposits at the bank we study were more risk sensitive than non-maturity accounts, running off earlier and faster in response to stress. This is at odds with many economists' intuition,but likely reflects the relative sophistication of term depositors, who tend to be corporate entities, and the inherently forward-looking nature of a non-demandable deposit. As depositors know the money will be harder to withdrawal, they may choose to do so at the first signs of trouble, whereas holders of more liquid accounts may be more willing to wait until problems become more apparent as their cost of exiting is much lower.

Second, we show that even in the last few months of the bank's life, when its failure appeared imminent, it was able to attract large quantities of institutional term deposits from banks, credit unions, corporations, municipalities and other non-person entities. These deposits were structured to fall just under the insurance limit and offered above-market rates. It replaced nearly a third of its total deposits in this manner in the last year of life, mostly in the last 90 days. This is concerning for several reasons. First, it implies that depositor discipline, Basel's third pillar of financial stability, was at best weakly operative at the bank. Second, by allowing the bank to survive longer than it otherwise would have, these institutional deposits may have allowed bank management to "gamble for resurrection," increasing resolution costs for the FDIC. Third, this finding suggests that the deposit rate restrictions which the bank faced during the period, restrictions explicitly intended to prevent rapid deposit acquisition by unhealthy banks, are not effective. Finally, this also highlights a channel by which the bank was able to shift credit risk exposure (to the bank's credit risk) from uninsured depositors to the FDIC just as it approached failure.

Additionally, using a set of regressions, we demonstrate that FDIC insurance and other government guarantees, including TAG, significantly reduce the withdrawals of insured depositors in response to ailing bank health. Our results support the notion that deposit insurance does indeed improve funding stability. We additionally find that checking accounts are more stable than savings accounts, and depositors receiving regular deposits consistent with direct-deposited paychecks are less likely to withdraw. These regressions also support the finding from the historical analysis that term deposits at this bank were more risk sensitive and less "sticky" than non-maturity deposits.

Finally, we use our novel data to study the LCR and NSFR rules which are currently deployed around the globe. While the LCR runoff rates assumed by US supervisory agencies appear appropriately conservative, the NSFR runoff rates may be too low, especially during periods of extreme stress. While ambiguities in the rules give rise to a range of possible rule-implied run off rates, the bank's NSFR-comparable run off rates exceed the rule-implied rates at some point under all approaches to resolving those ambiguities. In addition to assessing the realism of the LCR and NSFR run off rates, we also leverage our unique data to highlight and quantify two important areas of ambiguity: Do the rules' assumed run off rates allow for new depositors to offset exiting depositors? And, how are operational (loosely, cash management) business accounts classified? Given that a bank can substantially reduce the stringency of the rules by classifying as many deposits as possible as operational deposits, the existence of this ambiguity is particularly concerning, and may reduce the effectiveness of the rules.

The remainder of the paper is organized as follows: Section 2 discusses the data and the definitions of variables we construct and use in our analysis. Then, Section 3 provides a brief history of the bank to provide context for the later analysis, and also highlights a number of key findings. Section 4 presents the regression results, and 5 present our analysis of the LCR and NSFR rules in relation to the bank. Section 6 concludes.

2 Data

Our dataset is constructed from data collected by the FDIC shortly after the bank's failure. From records of the bank's deposit accounts and depositors, we construct end-of-day account balances for each deposit account. We associate accounts with their primary owner and his or her relevant characteristics using data maintained by the bank. We are able to reliably construct daily deposit account balances from early 2006 until the bank's failure. Additionally, we observe all account transactions over the period, including a reasonably granular description of the nature of the transaction and the transaction amount.

To ensure the validity of our data, we conducted several data validation exercises which supported our results. Most obviously, we compared the daily deposit balance totals at quarter-ends to the bank's regulatory reports. This comparison is shown in Figure 1. The mean absolute percentage error (MAPE) is 3.20% and the mean absolute error (MAE) is $40 million. For comparison, total deposits at the bank varied between $1 and 1.5 billion over our sample period. Some degree of error in total deposit balances is reasonable, particularly given the volume of daily transactions, transaction reversals, and uncertainty regarding the precise day on which those transactions were recorded in the bank's systems. That is, daily float could explain much of the errors. Additionally, we compared various deposit category balances with their regulatory report counterparts and also compared Summary of Deposits (SOD) data on deposits by physical branch with the bank's internal branch identifier for accounts. The results were similarly supportive of our data, allowing for some systematic errors, such as the overnight sweeping of some transaction account balances into non-transaction accounts. Banks engage in such sweeps to lower their required reserves, but the actions are not recorded in our data. We also did an additional check on individual account balances, by ensuring that accounts have zero balance before account opening and after account closing, for accounts that open and closed in our observed period. In summary, these exercises support the validity of our data.

2.1 Variable Definitions in Regressions and Summary Statistics

To study the characteristics of deposit(or)s associated with the stability of deposits, we measure a variety of account and depositor attributes using the failed bank's raw data. All variables defined in this subsection will be used in the regressions of Section 4, and the next subsection covers variables used only in the summary statistics tables. We define variables as follows:

- *Liquidation.* This dummy variable is used as the dependent variable in the regressions below. It is intended to capture a generally accepted notion of account liquidation which is consistent with recent, related studies on depositor behavior in response to stress. Specifically, in the Cox proportional hazard model (which utilizes the time dimension of our data, in addition to the cross-section) it is equal to 1 on the day in which a deposit account balance falls below 50% of the account balance as measured at the beginning of the measurement period as long as the balance stays that low or lower for at least 2 months. It is 0 otherwise. Accounts with non-zero balances that then close would therefore meet these criteria, as would accounts that withdraw a significant amount of funds but stay open. For cross-sectional models (linear probability and probit models), it is equal to 1 if, at any point in the measurement period, the depositor's account balance went below 50% of balances as measured at the beginning of the measurement period and stayed that low or lower for at least 2 months.

- *Over FDIC Limit.* This dummy variable is equal to 1 if there are any uninsured balances in the account as determined by FDIC insurance limit categories as of the start of the measurement period. It is 0 otherwise. As FDIC insurance determinations can be extremely difficult, this variable is constructed as conservatively as possible. Accounts marked as a 0 definitely have no uninsured funds in them. Accounts with a 1 *should* have uninsured funds in them, but are *possibly* fully insured due to joint account and trust rules that cannot necessarily be determined by the structured bank data. Therefore, while all accounts marked as insured are correctly assigned, the pool of uninsured accounts may include some insured accounts as well. This will bias any effects of being over the FDIC limit towards zero, so estimates in our regressions are lower bounds of the effects of being over the FDIC insurance limit.

- *Covered by TAG/DFA.* In addition to normal FDIC deposit insurance, some deposit accounts in the US were covered by additional, temporary guarantee schemes in the years after the financial crisis. The two additional guarantee schemes were the Transaction Account Guarantee (TAG) program and guarantees mandated by the Dodd Frank Wall Street Reform and Consumer Protection Act ("Dodd Frank Act" or DFA), both administered as additional insurance coverage from the FDIC. TAG, a sub-program of the FDIC's Temporary Liquidity Guarantee Program (TLGP), placed temporary but unlimited (in dollar terms) guarantees on negotiable order of withdrawal (NOW) accounts, non-interest earning demand deposit account, and interest on lawyers trust accounts (IOLTAs), which comprise all categories of checking accounts at this bank.

The TAG guarantees were in force until from October 14, 2008 until December 31st, 2010. While institutions were not required to participate in this additional insurance under TAG, and banks had to pay for the additional insurance, most banks (including the bank studied here) participated. The DFA guarantees similarly provided unlimited insurance for non-interest earning demand deposit accounts and IOLTA accounts, though not NOW accounts. The DFA guarantees were in force from December 31st, 2010 until December 31st, 2012. For periods prior to either program, we replaced the TAG/DFA dummy with a dummy variable which is equal to 1 if the account is a checking account and over the FDIC limit as of the start of the measurement period and 0 otherwise. This is true for the Placebo period and the Pre-Crisis period, when this dummy is used to establish a baseline behavior for these types of accounts. During the post crisis period, the TAG/DFA dummy will give the effect of both the inherent behavior of these types of accounts (large checking accounts, essentially) but also the effects of the guarantee. Comparing with the earlier periods, we are able to disentangle the two effects. Because the guarantee regimes change midway through the Formal Enforcement Action period (see below), we only mark accounts covered by the Dodd Frank Act guarantees with 1 for this dummy in the Formal Enforcement Action period. This variable is always 0 for term accounts, which were never covered by the programs.

- *Checking.* This dummy variable is equal to 1 if the account is a checking account and 0 otherwise. Our definition of checking accounts is comprised of interest and non-interest checking accounts, as well as NOW accounts, but not money market accounts or other savings accounts. Our definition of checking accounts was constructed to agree with the definition of transaction accounts in Federal Reserve Regulation D. This variable is always 0 for term accounts.

- *Prior Transactions.* This is the proportion of days in the past year,[2] as of the start of the measured period, in which the account holder performed at least one deposit or withdrawal involving the account under study. A value of 0 thus implies no activity and 100 implies activity each day.[3] We expect a priori that completely abandoned and forgotten accounts, ones with effectively no transactions over the past year, are unlikely to be liquidated as the owners may have forgotten about them or are otherwise not informed about the condition of the bank. Accounts where customers are using them somewhat more frequently are likely to pay attention to the condition of the bank and would thus be more likely to withdraw in response to stress. However, as the individual uses the bank even more frequently, costs of switching to another bank will be higher due to the need to manage payment flows and direct deposit, making them less likely to withdraw their balances. We thus predict this term will be positive in linear terms and negative in quadratic terms to account for these features. This variable is always 0 for term accounts, which generally do not post transactions.

- *Log(Age).* This is the natural log of the age of the primary account holder's oldest deposit account at the bank, measured in years, as of the start of the measurement period. If a depositor's original account has already been closed but the individual still has other accounts with the bank, the age of the relationship is based on the age of the original account. If an individual was a secondary depositor on an account before they became a primary account holder on another account, we use the date at which the joint account was opened, as this is still considered an existing deposit relationship. Older accounts should be more attached than newer accounts, and the term is included as a natural log to allow it to be diminishing over time. This can imply either a deeper preference for the bank or simply depositor inertia. The age of the account is dated

[2] We define "year" here to mean 365 days, as our dataset includes weekends.

[3] In calculating this variable, we exclude account activity which is exogenous to the depositor, such as routine, monthly interest credits, but we do include debit card purchases.

differently in the case of placed deposits, see the discussion of placed deposits below for more details.

- *Institutional.* This dummy variable is equal to 1 if the account is owned by a bank, credit union, financial corporate, municipality, or other corporation, or if it is a business product type as marked in the bank's product records. Business are likely both more informed about the conditions of the bank but also face higher switching costs due to the need to acquire necessary bank services. We do not have strong priors as to the impact of this variable as a result.

- *Recurring Deposit.* This dummy variable is equal to 1 if depositors are receiving a recurring deposit, in the form of a paycheck or sweep from brokerage account for example, as of the start of a measurement period. It is 0 otherwise. Depositors are considered to have a recurring deposit of this sort if they receive regular ACH deposits every 2 weeks (within a 2 day tolerance band). These depositors should have higher switching costs of leaving the bank and thus be less likely to liquidate. This value is always 0 for term accounts.

- *Placed Deposit.* This dummy variable is equal to 1 if the deposit was placed by a fiduciary or broker instead of by an individual depositor. It is 0 otherwise. Many CDs at the bank are not held by individuals but instead held by institutions acting as fiduciaries for others and thus may or may not reveal the identity of the underlying holders of the account to the bank. These deposits should imply a less personal connection with the bank and a higher runoff rate. For these accounts, the age of the account variable is dated to the start of the individual account, not the reported holder of the account, as each individual account may have a different true owner and the reported holder is only a fiduciary that does not make final withdrawal decisions.This value is always 0 for transaction accounts. Note that we assume all placed deposits are insured. This assumption is supported by internal FDIC analysis of several failed banks, which found that nearly all brokered deposits at those other banks were insured. Our notion of placed deposits includes brokered deposits, as well as functionally similar placed-but-not-brokered deposits. Additionally, we have reviewed the websites of a sample of the deposit placement services which interacted with our bank, and they generally advertise that they structure their placed deposits so as to achieve full insurance coverage. Note that because we generally don't see the underlying depositors for placed deposits, making a more granular insurance determination is not possible.

- *Days Until Next Maturity.* This is the natural log of the number of days until the maturity of the account as of the start of the measurement period. Term accounts further away from maturity should be less likely to liquidate due to early breakage penalties. This value only exists for term accounts. This value is always 0 for transaction accounts.

2.2 Variable Definitions in Summary Statistics Only

- *Loan Linkage.* This dummy variable is equal to 1 if the depositor has a loan linkage (as defined by two of the three loan databases used by the bank, as documentation in the third database was not complete enough to create consistent loan linkages, with loan linkage numbers being extremely small in any case) in either the past, present or future. It is 0 otherwise.

- *Starting Balance.* This variable captures the balance in the account, in thousands of USD, as of the start of the measurement period.

- *Average Rate.* This variable is the daily average interest rate paid to the account over the measurement period.

- *Initial Rate.* This variable is the interest rate paid to the account at the start of the measurement period or when it was opened, depending on whether the account existed at the beginning of the measurement period or not.

- *Average Spread.* This variable is the average interest rate spread paid on the account over the measurement period compared to RateWatch average weekly data for that period interpolated to a daily frequency.[4] For deposit products for which RateWatch does not construct a series, we average the rates for the two adjacent CD categories. Thus, the 30 month CD will be the average of the 24 and 36 month CDs, then interpolated from weekly to daily frequency. For CD terms shorter than 3 months, we use the RateWatch 3 month series, and for CD terms longer than 60 months we use the RateWatch 60 month series.

- *Initial Spread.* This variable is the interest rate spread paid on the account at the start of the measurement period or when it was opened, depending on whether the account is an extant or new account, compared to RateWatch weekly data for that period interpolated to a daily frequency. For deposit products for which RateWatch does not construct a series, we average the rates for the two adjacent CD categories. Thus, the 30 month CD will be the average of the 24 and 36 month CDs, then interpolated from weekly to daily frequency. For CD terms shorter than 3 months, we use the RateWatch 3 month series, and CD terms longer than 60 months we use the RateWatch 60 month series.

- *Average Daily Withdrawal.* The average daily withdrawal amount over the measurement period.

[4] Although RateWatch conducts surveys of deposit rates every business day, they only complete full survey cycles once a week, meaning that the data are effectively weekly in their raw form.

- *Average Daily Deposit.* The average daily deposit amount over the measurement period.
- *Number of Daily Withdrawals.* The average daily number of withdrawals over the measurement period.
- *Number of Daily Deposits.* The average daily number of deposits over the measurement period.
- *Days with Withdrawals.* The share of days with withdrawals over the measurement period.
- *Days with Deposits.* The share of days with deposits over the measurement period.
- *Types of Account at Bank.* This variable is a count variable taking a value 1 to 3 for how many depository products at the bank the customer ever has, for each of the three products CD, Checking, and Savings.
- *Oldest account is CD.* This dummy variable is equal to 1 if the oldest extant account for that depositor is a CD, and 0 otherwise.
- *Oldest account is Savings.* This dummy variable is equal to 1 if the oldest extant account for that depositor is a savings account, and 0 otherwise.
- *Oldest Account is Checking.* This dummy variable is equal to 1 if the oldest extant account for that depositor is a checking account, and 0 otherwise.

2.3 Defining Time Periods of Special Relevance

As a final note before delving into the analysis, we define some nomenclature related to time periods of particular interest. In the regressions of Section 4, we analyze depositor behavior in four windows of time. We also use these time periods to some extent in the discussion of

Section 3. We identified these time periods using the bank's data and macroeconomic events in order to highlight important findings. While the precise reason for our choice of periods will become clear momentarily, the four periods, in brief, are:

- *Placebo.* We utilize a period of time in 2006 as a placebo period, establishing baseline depositor behavior outside of periods of stress. We chose the period because it is well before the crisis (necessary for a placebo) and as far back as possible with the data still being reliable. Data prior to the Placebo period is less reliable, as the bank did not maintain complete records that far back due to changes in deposit systems.

- *Pre-Crisis.* The next time period we focus on is the year-long period before the financial crisis which we date starting September 2008. One might expect depositors to show some signs of financial stress in increasing liquidation. In this period, uninsured deposits began running off, specifically uninsured term deposits. We end this period before September 2008 and intentionally exclude the crisis from the period. We refer to this as the Pre-Crisis period.

- *Post-Crisis.* The Post-Crisis period begins shortly after the government's emergency actions in fall 2008. We exclude a few months in the fall of 2008 primarily to avoid confounding factors which would obscure the relationships of interest. The large variety of emergency actions by the US government occurring in a short span of time, as well as markets' expectations related to these actions before their implementation, has the potential to generate unintuitive depositor behavior and make it difficult to causally identify the effects of any given program. For instance, after the Reserve Primary Fund, a money market mutual fund (MMMF), "broke the buck" in September 2008 and haircut its shareholders, funds flowed from MMMFs into the banking system seeking the safety of deposit insurance. To stop the run on MMMFs, the US Treasury introduced a temporary guarantee of MMMF share prices, with no limit on the insured balances. With unlimited insurance for MMMFs and the deposit insurance insurance limit still at $100,000, there was a brief period in which the run reversed; funds moved from the banking system to the money market (**citations**). Of course, deposit insurance was substantially expanded soon after. While this is certainly an interesting episode, we do not wish to contaminate our estimates of the effect of deposit insurance with such confounding factors. As one might expect, the Post-Crisis period was a period of considerable financial distress for all banks, which we will show was reflected at our bank.

- *Formal Enforcement Action.* Well after the crisis but about a year before the bank failed, its primary federal regulator issued a formal enforcement action against the bank. The enforcement action was intended to address the declining health of the bank and prevent its failure, though it was of course not successful in this aim. We refer to the period between the enforcement action and bank failure as the Formal Enforcement Action ("Formal") period. Like the Pre-Crisis and Post-Crisis periods, this was also a period of significant distress. Unlike those earlier periods, though, the stress was bank-specific, rather than market-wide or macroeconomic in nature.

3 Historical Background: Depositor Withdrawals and Deposit Composition

This section will provide a more detailed history of the bank, both to motivate later empirical results as well as for its own sake. Many of our key findings are visible from or suggested by this historical analysis.

3.1 Brief History of the Bank

Until mid-2007, this bank appeared relatively health with little evidence of stress. The balances in less-than-fully insured (henceforth, "uninsured") accounts, both non-maturity and term deposits, were steadily rising (see Figures 2 and 3). As we will discuss in Section 4, our regressions also support this assertion; most importantly, deposit insurance had comparatively little power to explain account liquidation behavior, which we interpret as a lack of concern regarding the bank's credit risk.

By mid-to-late 2007, signs of stress are evident. Between mid-2007 and August 2008, there was net runoff in uninsured balances. Figures 2 and 3 show that the runoff was particularly rapid among term deposits. While less than 40% of uninsured non-maturity balances ran off during the period, over 50% of uninsured term deposit balances did so. There was comparatively little systematic variation in insured deposits, likely due to the presence of deposit insurance. While this period excludes the worst of the financial crisis, stress was clearly building in the financial sector, particularly in securitization and money markets. Moreover, this period includes the high-profile failures of Bear Stearns and IndyMac in the US and the run on Northern Rock in the UK. Thus, it is not surprising that depositors, particular more sophisticated depositors, would begin to react.

Our finding that uninsured term deposits responded to stress and ran off earlier than non-maturity deposits is, at first, surprising. It is particularly important given that banks and regulators often consider term deposits to be a more stable source of funding than many non-maturity accounts. Although this term deposit stability assumption appears intuitively appealing, our data suggests otherwise; and we posit a couple of reasons for the phenomenon. First, term deposit investors, particularly uninsured term deposit investors, tend to be relatively sophisticated. A greater share term depositors than non-maturity depositors are corporate entities at our bank, and these corporate entities might be expected to manage their assets more carefully. Insured and non-maturity depositors are more likely to be individuals investing on their own behalf. Second, the decision to open or rollover a term deposit is inherently more forward-looking than decisions regarding non-maturity accounts. Because term deposits have a fixed maturity, term depositors are likely to consider the long-term health of the bank more carefully than depositors who can withdraw their funds penalty-free, on demand, often by writing a check or logging into their bank's website.[5] Supporting the assertion that term depositors viewed their investments as non-callable, we observe few early CD breakages.

The crisis in the fall of 2008 was a period of acute financial stress as well as significant changes in financial policy. The most important policy change for our purposes was the increase in the FDIC's deposit insurance limit from $100,000 to $250,000 effective October 3, 2008.[6] Additionally, the FDIC's TAG program became effective on October 14, 2008, temporarily providing unlimited deposit insurance for negotiable order of withdrawal (NOW) accounts, non-interest-bearing demand deposit accounts, and interest on lawyers trust accounts (IOLTAs), which comprised all categories of checking accounts at this bank. The change in deposit insurance is evident in Figures 2 and 3, where uninsured deposits drop precipitously and insured deposits jump upward between the Pre-Crisis and Post-Crisis periods denoted with grey bars.[7] The bulk of the sudden change in deposit composition is mechanical, as deposit accounts over $100,000 suddenly became insured. The change in insurance status among term deposits is driven entirely by the higher, but finite, limit for all deposit accounts; the TAG guarantees did not apply to term deposits. Some of the change

[5] This second rationale is partly behavioral; generally speaking, this bank's term depositors did not pay an early withdrawal fee beyond forfeiting interest earned, and sometimes paid less than that. Over our sample period, a few dozen early CD breakages resulted in penalties which exceeded earned interest by as much as 2% of the principal balance (usually 1% or less), but most of these penalties were promptly reversed by the bank and credited back to the depositor. Thus, there were effectively very low costs to early CD withdrawal. Nonetheless, term depositors appear to have behaved as though they were making the deposits for the entire CD term. The very low rate of early CD breakage supports this assertion.

[6] Initially, this increase was only temporary, through the end of 2010, but it was subsequently made permanent by the Dodd Frank Act.

[7] These periods will be explained more fully below.

among non-maturity accounts reflects TAG guarantees.

Further supporting our assertion that term depositors at the bank were more risk sensitive, uninsured CD balances never increase substantially after October 2008. From then until the bank's failure, there were roughly 100 CD accounts which we flag as potentially uninsured. However, as noted above, our measure of insurance coverage is not perfect. In particular, while we can say definitively that accounts we consider to be fully insured are in fact insured, there may be some accounts we flag as potentially uninsured that are also insured. Given their unresponsiveness to stress shown in Figure 3 and in unreported regressions close to bank failure, it is possible that most or all of these remaining term deposits were insured. In contrast to term deposits, and reflecting their lower risk sensitivity, uninsured non-maturity deposits continued to accumulate, even during the remainder of the financial crisis and recession. Note that we considered TAG-covered accounts to be insured for the purposes of this discussion. They only began to run off again (in the aggregate) after the formal enforcement action, shortly before the bank's failure.

This depositor behavior suggests that the time between the financial crisis and the formal enforcement action (discussed below) was one of limited stress. The acute market-wide or macroeconomic stress of the crisis had receded and the bank's health had not yet deteriorated to a critical point. Thus, only the relatively risk sensitive term deposits reflect the stress in that they do not return to the bank.

Then, roughly a year before the bank's failure, its primary federal regulator took its first publicly announced action to address the declining health of the bank.[8] The bank's primary regulator sent a Troubled Condition Letter (TCL) followed shortly by a Cease and Desist (C&D) order. Following normal policy, the C&D order was made public immediately and

[8]The bank had previously been subject to a non-public memorandum of understanding (MOU) with its regulator. That MOU was intended to address many of the same problems which led to the bank's demise. Such confidential informal enforcement actions are a common element of regulators' response to ailing bank health in the earlier stages of decline, when failure is still relatively unlikely.

appeared in the local press within a couple of business days. The C&D order was described by one banking analyst quoted by the local press as unusually harsh and indicative of very high supervisory concern about the bank. The C&D order was also very broad in the issues it identified, including insufficient capital, inadequate board oversight, deficient and incompetent management, problematic internal policies, and inaccurate financial reporting. Around the same time, shortly after the non-public TCL and before the public C&D order, the reports in the local press remarked on the bank's poor health as revealed in financial ratios. The reports were likely based on the release of a quarterly regulatory report which we believe happened at about the same time.[9]

Unsurprisingly, given the negative attention on the bank, non-maturity depositors responded strongly to the news, with an increase in aggregate runoff. Even insured non-maturity deposits ran off over the period, though not nearly as rapidly as did uninsured. As noted above, there were few uninsured term deposits left at the bank, and little stress is evident in term deposits.

Finally, three to four months before it failed, the banks' public regulatory filings (including amendments to previously filed and published filings) began showing the bank to be "significantly undercapitalized" and, within weeks, "critically undercapitalized." 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 ratio of equity to assets (that is, their leverage ratio) falls below 2%; that is, if they are nearly insolvent. Importantly, Prompt Correction Action (PCA) guidelines generally require federal regulators to place a bank into receivership or conservatorship (i.e., fail the bank) within 90 days of it becoming critically undercapitalized.[10] Although supervisors are allowed to delay closing a bank beyond 90 days under certain circumstances, this is fairly uncommon, and contemporary press

[9] We are unable to confirm the exact date of the regulatory report's release.

[10] See 12 U.S.C. §1831o for more detail.

coverage of the bank supported the idea that such a delay was unlikely. Thus, depositors could expect the bank to fail very soon. As might be expected, uninsured deposit run off accelerated substantially, as shown in the far right of Figure 2.

The basic assertion that term depositors were more risk sensitive that non-maturity depositors is also made evident by the composition of new depositors arriving at the bank *after* the formal enforcement action. Figure 4 shows that the bank was actually able to attract roughly the same volume of insured and uninsured non-maturity deposits for much of the period after the formal enforcement action, though those deposits ran off rapidly beginning around the time that the bank became critically undercapitalized.[11] In contrast, Figure 5 shows that the bank attracted essentially no uninsured term deposits.[12]

3.2 Deposit Composition

Strikingly, Figure 5 shows that the bank attracted a very large volume of new, insured term deposits over the period, mostly in the last 90 days of its life, after it became critically undercapitalized (see Figure 5). Over the full period from formal enforcement action to failure, it attracted about $400 million in insured term deposits from new depositors, nearly a third of its aggregate deposit base as of the formal enforcement action. More than half of those new deposits arrived in the last 90 days. This large inflow explains why total deposit balances declined little leading up to the bank's failure, as shown in Figure 1.

The large inflows reflect an important shift in deposit composition near bank failure, which is another of our key findings. Figure 6 captures the shift. Around the time of the

[11]Note that this statement does not contradict our earlier finding that aggregate insured and uninsured non-maturity deposits declined over the period. That finding was in the context of total deposits. Here, we are focusing on depositors who had not previously held deposit accounts with the bank - a strict subset of total deposit(or)s.

[12]Two points bearing repeating. First, some accounts we identify as uninsured are probably insured; that is, we (weakly) overstate the number of uninsured accounts. Second, what we refer to as "uninsured balances" are in fact total balances in less-than-fully insured accounts. Thus, even if uninsured deposits were given a 100% haircut during the bank's resolution, depositors did not stand to lose all of the funds we refer to as uninsured.

TCL and C&D order, placed term deposits, a major funding source for the bank, began running off rapidly. Of course, as shown above, both insured and uninsured non-maturity deposits were also running off, losing about $350 million over the period. As placed CDs and non-maturity accounts fled, the bank replaced them with institutional CDs structured to fall just under the insurance limit. Throughout this paper, we define "institutional CDs" as those CDs which were neither brokered nor placed and which were owned by financial institutions, non-financial businesses, and municipalities. However, nearly all of the new CDs attracted after the enforcement action were held by small banks, savings & loan associations, and credit unions from across the US.

The summary statistics in Table 1 provide another perspective on the change in deposit composition. The columns of the table present summary statistics for new depositors arriving at the bank in each of the four time periods we focus on, which correspond to the grey bars in Figures 2, 3, and 6. The statistics all treat an account as the level of observation, rather than considering account balances. The chronological ordering of periods runs from left (early) to right (late). The share of new deposit accounts which are uninsured at time of opening declines over time from 4.8% to 1.3%. This generally reflects the increasing stress facing the bank, and the low level in the Formal period reflects the fact that most deposit inflows in the Formal period were CDs structured specifically to fall within insurance limits. Relatedly, the share of CDs in total new deposits is increasing over time; in the Formal period, more than three-quarters of new accounts were CDs. New depositors in the Formal period were much less likely to have multiple deposit products (1.021 products in the Formal period as opposed to 1.097 deposit products in the Placebo) and much less likely to also have a loan with the bank (.3% as opposed to .8%). Finally, 79% of new deposits in the Formal period came from institutional depositors, up from 4.3% in the Placebo.

This change in deposit composition is important for several reasons. First, it suggests that depositor discipline was probably ineffective in restraining bank risk-taking. While some depositors enforced discipline on the bank by leaving, others offset the disciplining effect by opening new accounts. This finding is concerning especially because the Basel framework considers market (in this context, depositor) discipline of banks to be the third of three "pillars" of financial stability. Our results suggest that depositor discipline may not be a reliable source of financial stability.

Second, by preventing the bank from failing for lack of funding, these new deposits extended the life of the bank. The pessimistic view is that this phenomenon would allow fundamentally insolvent banks to survive for some length of time. US experience, especially in the Savings & Loan Crisis of the 1980s, has demonstrated that prolonging the life of insolvent banking institutions can be costly; providing more time for them to "gamble for resurrection" tends to increase the cost of resolving them when they ultimately fail . This argument is supported by the fact that the bank had largely ceased new lending a few years before failure. The timing of the bank's failure largely reflected the timing pattern of the bank's accounting recognition of credit losses in its portfolio. Although these credit losses may not have been obvious prior to their accounting recognition, with our benefit of hindsight, the losses were already largely embedded in the portfolio with bad loans already made; to the extent that credit losses killed the bank, the bad loans had been made before the change in deposit composition. Whether the bank's management was aware of that fact or acted on it by gambling for resurrection is unclear. A more optimistic view would be that inflows of insured term deposits are a benign event which primarily serve to preserve banks' funding and reduce the risk of liquidity failures among solvent banks. This view is generally supported by the that, of all US banks which received a formal enforcement action (the event which appears to have precipitated the change in deposit composition at our bank) between 2000 and 2012, only about 25% have since failed. [13] That suggests many banks

[13] A common response to a formal enforcement action is to find an acquiring partner as well, and the failure of a bank to find an acquirer may indicate a particularly bad loan book.

facing formal enforcement actions are solvent. Then again, as noted above, the enforcement action against our bank was particularly harsh.

Third, the large inflow of new deposits suggests that deposit rate restrictions placed on troubled banks are not sufficient to prevent rapid insured deposit acquisition. To prevent troubled banks from growing rapidly by attracting brokered deposits, US banking laws prohibit banks from continuing to accept brokered deposits unless they are either well capitalized (the highest of the five PCA capital ratio categories) or have a waiver from supervisors. To prevent banks from circumventing this restriction by offering high interest rates to attract non-brokered deposits, undercapitalized institutions also may not pay deposit rates more than 75 basis points above the national average deposit rate on new accounts, again, unless they obtain a waiver. The relevant national average deposit rate is calculated and published weekly by the FDIC. See FDIC (2016) for more details on these restrictions.

The bank we study was subject to these restrictions during the period after the formal enforcement action, and yet they were able to attract deposits equal to a third of their deposit base in the last year or so before failure. Table 1 shows that the bank complied with the rate restrictions; the spread on new accounts in the Formal period was around 65 basis points.[14] Because the bank was able to attract so many new deposits while under the restrictions, we conclude the rate restrictions were at best a minimally binding constraint on the bank's behavior. Relatedly, it is interesting to note that the bank consistently, over the full period from 2006 to failure, paid rates well above national averages. They continued to do so, and to attract deposits, in the Formal period, even though the spread tightened, at least partly as a result of the rate restrictions, and partly due to the changing nature of

[14]Note that the spreads reported in the table are relative to a slightly different national average rate than that defined by the FDIC. We calculate our own national average series using a method identical to that used for the official national rate data. We use our own data rather than FDIC's official data because the official data do not cover our entire sample period. We use our data to ensure consistency across our sample. The source data underlying the official average data changes with vintage, and we have not been able to recover the correct vintages. As a result, our averages tend to differ slightly from the official data. The same qualitative conclusions result from using the official data over the supported period, however.

competition for bank deposits at this time.

The final reason the shift in deposit composition is important is that the shift also served to quietly transfer risk to the FDIC. While the fleeing placed CDs and insured non-maturity accounts were insured, about $150 million of uninsured non-maturity deposits also ran off. Because the bank was largely successful in replacing these fleeing deposits with insured institutional CDs, the share of the bank's deposits covered by insurance increased. This served to increase the FDIC's exposure to the bank's credit risk just as it was failing; that is, it shifted credit risk to the FDIC. Note that because current FDIC deposit insurance assessments are based on banks' total assets, this increased exposure would also not be priced into the deposit insurance, meaning that the cost of deposit insurance assessments does not discourage this behavior. Similarly, deposit insurance assessments before April 2011 were based on banks' domestic deposits, meaning the same feature of deposit insurance existed before 2011, as well.

4 Depositor Characteristics and Account Liquidation

This section employs regressions to formalize some of the key results from the previous section. We regress the account liquidation dummy on account and depositor characteristics in the context of Cox proportional hazard, linear probability (LPM), and probit models. Because the liquidation behavior of term deposits is conceptually and empirically quite different from that of non-maturity deposits, we run regressions separately on the two categories. For non-maturity deposits, we run the models on four separate sample periods, one for each of the four time periods described above: Placebo, Pre-Crisis, Post-Crisis, and Formal Enforcement Action. We chose these four periods carefully, based largely on the analysis documented in the previous section, to capture periods of particular interest. For term deposits, we run regressions on three of the four periods; we exclude the Formal period because, as previously discussed, term deposit liquidations are not a significant feature of our data in the Formal period. This is mainly because uninsured CDs ran off prior to the financial crisis and never returned. With respect to term deposits, the most interesting phenomenon in the Formal period is the massive run *in* of institutional deposits. The regressions of this section do not capture that phenomenon.

In the discussion of the results, we will generally compare the Cox model results across different time periods. The Cox results are expressed as hazard ratios, meaning that they can be sensibly compared in spite of the fact that the time periods of the regressions are of different length. The variation in sample length makes direct comparison of LPM and probit results potentially misleading.

Two additional points are worth nothing here. First, throughout all regression results, standard errors are clustered at the depositor (natural person or legal entity) level. Second, we include dummies in all regressions for the physical bank branch to which a deposit account is linked in the bank's internal data. We do not, however, report the coefficient estimates for the branch controls.

4.1 Non-Maturity Deposits

Focusing first on non-maturity deposits. Tables 3, 4, 5, and 6 present the regression estimates. The regression results for non-maturity deposits show that deposit insurance is effective in making deposits more stable. They also show that the TAG guarantees were equally as effective. Further, our results provide support for intuition embodied in bank liquidity regulation, particularly with respect to checking accounts and the effect of direct depositing of paychecks. In reviewing the results, we will also see further evidence of a finding from the previous section: non-maturity deposits were relatively less risk sensitive than term deposits. Non-maturity account regressions generally don't show evidence of financial distress until after the fall of 2008, and the stress peaks only in the last year before bank failure. In contrast, the term deposit regressions will show evidence of stress earlier; as noted above, there were little or no uninsured term deposits remaining at the bank by late 2008.

The Placebo period (Table 3) establishes a baseline for "normal" depositor behavior when there is little financial stress. Recall that the Placebo period is in 2006.

First, we find that deposit insurance is effective in improving banks' funding stability. Accounts over the FDIC insurance limit were more likely than other accounts to liquidate, even during the Placebo period. Over the period, such accounts were liquidated at a rate about 16% faster than the baseline hazard. In contrast, the interaction of the Over FDIC Limit dummy with the Checking account dummy is not statistically different from zero. This is a useful finding because, during and after the crisis, exactly this set of accounts was covered by the temporary, unlimited FDIC insurance provided by TAG.[15] This result establishes that such accounts are not more or less likely to liquidate than other accounts, in normal times. That baseline against which to contrast later results will allow us to better quantify the stability-improving impact of TAG guarantees.

Next, our results support the widely-held belief that checking accounts are a comparatively stable funding source. In the Placebo period, depositors liquidated checking accounts at only a little more than half the baseline hazard rate. Regulatory agencies have embedded this belief in rules, such as the LCR and NSFR, which we will discuss at greater length below. To be considered the most stable form of funding for LCR and NSFR purposes, deposit accounts must be fully insured and either be a transaction account or be held by a depositor with other relationships with the bank (such as loans, bill payment services, etc.). Note that our definition of "checking account" is synonymous with the definition of "transaction account" in Federal Reserve Regulation D.

Similarly, we find that accounts which are receiving regular ACH transfers roughly every

[15]Strictly speaking, the sets of accounts are not identical because the deposit insurance limit also changed between the Pre-Crisis and Post-Crisis periods.

two weeks (indicative of direct-deposited paychecks) are also less likely than other accounts to liquidate. This finding also supports intuition embodied in the LCR and NSFR rules. The Basel proposal for LCR specifically notes that transaction accounts should, on average, be more stable, at least partly because they are the types of accounts into which depositors might have salaries deposited.

We also control for a number of other account and depositor characteristics. Because there is relatively little interesting variation across time periods in our coefficient estimates for these additional controls, we will discuss them only once. Older accounts are slightly more stable: the point estimates indicate that they are less likely to liquidate, though the estimates are not always statistically significant. The rate at which depositors conduct transactions has a significant, non-linear relationship with liquidation behavior. The result turns out to be fairly intuitive. Accounts on which depositors only occasionally transact are more likely to liquidate than other accounts. This reflects the fact that the depositor is generally aware of the account's existence (they occasionally transact), as opposed to forgotten accounts which never transact and liquidate relatively less often. As the frequency of transaction rises, the negative coefficient on the squared term quickly comes to dominate the positive linear term. Thus, as the depositor uses the account more (suggesting its functionality is more critical to the depositor), the account becomes less likely to liquidate than the baseline. Finally, non-maturity accounts held by institutional depositors are not significantly more or less likely to liquidate than the baseline account.

Moving to the Pre-Crisis period in Table 4, we see that very little has changed. This is generally consistent with the historical discussion above in which non-maturity deposit accounts showed relatively little stress before the crisis. The same result will not be true for term deposits. Column 4 of Table 4 shows which Cox model coefficients are statistically different from their Placebo period counterparts.[16] Only the Institutional dummy coefficient

[16]We assess significance using a t-test assuming the two coefficients are independently distributed random

is statistically different from its Placebo period counterpart, though it remains statistically indistinguishable from zero. The point estimates for the impact of deposit insurance are slightly smaller than in the Placebo period, but they are not statistically different.

Stress among non-maturity depositors becomes evident in the Post-Crisis period (Table 5), when most coefficients are statistically different from their values in the Placebo period. Surprisingly, the deposit insurance dummy is not statistically different from its earlier value, but the point estimate is much larger: such accounts liquidate at a 48% higher rate. Of course, this impact remains statistically different from zero, just not from the comparable estimate in an earlier period.

Additionally, these regressions suggest that TAG guarantees were effective in preventing liquidation; in fact we find that they were just as effective as regular deposit insurance. This is the first period in which TAG was in place, and the coefficient estimates are now statistically significantly negative (they were zero in prior periods) and significantly different from earlier estimates of the interaction of the insurance and checking dummies. Comparing the point estimates in the first two rows of the table, we see that they are about the same (and they are not statistically different), indicating that TAG is similiar in its effectiveness as deposit insurance. However, the number of accounts covered by TAG is small and this result will likely have a high standard error for this coefficient.

Relative to earlier periods, checking accounts are less stable under stress. However, they are still more stable than non-checking non-maturity accounts (i.e., savings accounts).

Finally, in the Formal period, stress among non-maturity depositors peaked (Table 6). Most importantly, the impact of FDIC insurance is statistically stronger than in the Placebo period; uninsured accounts now liquidate at a rate 70% faster than the baseline account. The fact that deposit insurance had such a large effect on liquidation behavior supports the assertion that this was a period of high stress for the bank. Given that deposit insurance

variables. This method is based on Paternoster, Brame, Mazerole, and Piquero (1998).

primarily protects depositors from the credit risk of the bank, depositors appear to have been quite concerned about the bank's credit risk. Moreover, deposit insurance seems to have alleviated this concern.

The result for the Covered by DFA dummy merits additional discussion. The TAG program ended during the Formal period, at the end of 2010. However, the Dodd Frank Act had separately mandated temporary, unlimited insurance on a similar set of accounts through the end of 2012. The only major difference between the coverage of the two forms of temporary insurance was that TAG covered NOW accounts and DFA did not. Thus, with the end of TAG, NOW accounts lost unlimited coverage.[17]

The expiration of TAG during the Formal period presents two empirical challenges which we address by excluding TAG coverage from the dummy variable. The dummy simply reflects DFA coverage. First, particularly given that the timing of TAG's expiration was announced well ahead of time, we would expect depositors in NOW accounts to liquidate balances which were scheduled to become uninsured. Moreover, we would expect them to do so before the end of 2010, when they still were covered by TAG, in order to avoid ever becoming uninsured. This would tend to generate a positive relationship between TAG and liquidation. Indeed, in unreported results, when we include TAG coverage in a Covered by TAG/DFA dummy in the Formal period, we find this association: accounts covered by TAG are more likely to liquidate. This rational behavior on the part of depositors would tend to obscure the effect of interest, which is one reason we exclude TAG coverage from the dummy altogether in the Formal period. The second complication relates to the fact that while the Cox model can include time-varying explanatory variables, the cross-sectional LPM and probit models cannot. Given that there is important time variation in the TAG dummy, we opt to exclude it from all regressions in order to avoid complicating the interpretation of the three models.

We find that DFA guarantees did not statistically significantly decrease the probability

[17] Such accounts of course continued to benefit from ordinary deposit insurance.

of account liquidation. To some extent, this reflects the fact that there were relatively few accounts of a type covered by DFA guarantees which were over the regular FDIC limit. As a result, the coefficients are estimated with less precision than were estimates for the TAG/DFA dummy in earlier periods, although the point estimates are relatively similar. An alternative interpretation is that DFA guarantees were less effective, perhaps because depositors did not understand them or were not aware of them. Particularly because the much more high-profile TAG guarantees expired during the period, it is plausible that many depositors were left confused.

4.2 Term Deposits

Next, consider the term deposit regressions. As noted above, we run regressions only on the first three time periods, excluding the Formal period. This follows from the fact that essentially all term deposits remaining at the bank were insured as of the Formal period, such that depositors' liquidation behavior turns out to be rather uninteresting. By way of a summary of results, the regressions support the findings from Section 3 that uninsured term deposits were more risk sensitive than uninsured non-maturity deposits, and they fled the bank earlier. We find that deposit insurance is again effective in improving deposit stability and we show that placed deposits exhibit a great deal of churn, liquidating often.

In the Placebo period (Table 7), we find that deposit insurance does not cause CDs to liquidate more or less often. Particularly in light of the strong effects in later periods, we interpret this as evidence that the Placebo period was a period of little stress, consistent with our expectation. Placed CDs are statistically significantly more likely to liquidate, and do so at a rate about three times as fast as other CDs, according the Cox model estimates. As was true for non-maturity deposits, we find that the age of a depositor's relationship with the bank is negatively associated with liquidation probability. Finally, Table 7 shows that the farther a CD is from its maturity date, the less likely it is to liquidate. This reflects the fact that very term deposits were withdrawn early, especially in the Placebo period.

Table 8 shows comparable results for the Pre-Crisis period. The Over FDIC Limit dummy is now statistically different from zero and different from its Placebo period value. Uninsured term deposits run off at a rate about 20% faster than insured deposits. Interestingly, the impact of days to maturity is attenuated, suggesting that early breakages are more common in the Pre-Crisis period.

Finally, Table 9 shows results for the Post-Crisis period. Point estimates for the impact of FDIC insurance are about the same or higher (depending on the model) as in the Pre-Crisis period. However, as shown in Section 3, very few uninsured term deposits remained with the bank. As a result, the dummy in the cross-sectional models loses statistical significance. In the Cox model, the greater number of observations available in the panel setting are sufficient to maintain significance. The Cox model estimates a very large impact of insurance on term deposit liquidation: uninsured CDs liquidate at a 70% faster rate. The results also show that placed deposits, which we expect would be particularly risk-sensitive, run off very rapidly, at 5.5 times the rate of the baseline deposit.

5 runoff Rates, LCR, and NSFR

As a final empirical exercise, we compare observed runoff rates at the bank to the ranges allowed in the LCR and NSFR rules which are now being applied to large banks. We provide evidence that, at least in the case of this bank, the LCR appears appropriately conservative; at no point did observed runoff at the bank unambiguously breach the LCR limits. In contrast, the NSFR does not appear sufficiently conservative in periods of extreme stress; during the crisis and close to failure, runoff rates exceeded NSFR thresholds, particularly under certain sets of assumptions. Of course, it is not clear that NSFR was intended to force banks to maintain sufficient stable funding to survive a full year of extreme stress.

Nonetheless, this is a result of which bank supervisors should be aware. We emphasize that our results should be extrapolated with some degree of caution because we are studying only one bank, and it was smaller than the institutions to whom the LCR and NSFR are actually applied.

In addition to providing an assessment of the realism of the rules' assumptions, we also highlight a couple significant areas of ambiguity in the rules as they are currently written. Because we have access to unusually granular banking data, we are able to comment on aspects of the rules which would have been difficult for the framers of the rules to anticipate or address.

First, however, a brief overview of the LCR and NSFR is in order. In broad terms, both rules are intended to reduce liquidity risk in the banking sector by requiring large and complex institutions to hold sufficient "liquidity/stability-adjusted" funding to continue funding their "liquidity/stability-adjusted" assets in the face of funding stress, thereby reducing the risk of asset fire sales to meet withdrawal demand, associated externalities, and liquidity-related failures.[18] The LCR is intended to ensure that LCR-compliant institutions have sufficiently stable funding to survive a 30-day period of acute funding stress. The NSFR considers a one-year horizon, though the level of stress assumed during the period is not clear from the language of the rule. The portions of the rules relevant to our paper are the assumptions about deposit run off rates. Specifically, to determine the value of their stability-adjusted deposits, banks must apply standardized runoff rates (provided in the rules) to their deposits and determine if the bank is sufficiently liquid to handle assumed runoff of depositors. The rules were initially proposed by the Basel Committee and are being implemented by country-level supervisory agencies. Because the US agencies have completed a final LCR rule, we use the runoff rates assumed in the US rule as the basis for comparison. As of this writing, the

[18]The liquidity adjustments are made using weighting factors analogous to the risk weights used in risk-based capital rules. Very generally, LCR and NSFR apply the same logic to liquidity as capital regulations do to capital.

US has not yet finalized an NSFR rule, although a proposed rule has already been published with a request for comment. As a result, we use the Basel proposal as the basis for the NSFR comparison. It's worth noting that the Basel and US rules (for both LCR and NSFR) are sufficiently similar that the results are not sensitive to these choices.

As noted previously, our unique data allows us to characterize two significant areas of ambiguity. Banks and their regulators are currently debating the details and ambiguities of these rules. It is our intent simply to highlight them in the published literature and assess the impact of the ambiguities on the stringency of the rules. The first area of ambiguity relates to assumptions about new deposit inflows. Specifically, were the runoff rates in the rules calibrated to reflect deposit drawdowns among only extant depositors (those with accounts at the bank as of the calculation date) or are new depositors who arrive at the bank during the calculation period allowed to offset some of the runoff? The rules are unclear in stating if banks should assume that there are new depositors bringing funding to the bank during the stress period. Clearly, allowing new depositors to offset any run off would result in less total runoff, or more run-in. Ultimately, this is largely a conceptual point, since banks subject to the rule simply apply the assumed run off rate; they don't need an answer to this ambiguity to comply. However, if the intent of the rules was that they only considers extant depositors (and disallow new depositors), our results indicate that the NSFR may be insufficiently conservative.

The second area of ambiguity, which appears to be well-recognized but so far unresolved by practitioners, relates to operational deposits. Operational deposits are business deposits which are maintained at the bank as part of an arrangement in which the bank provides clearing, custodial, or cash management services, including accounts used to pay variable business costs like payroll. The balance of a single deposit account can be split between an operational portion (that portion which is arguably placed at the bank for the above reasons) and a non-operational portion (implicitly, to earn interest income). There are no clear guidelines on how to determine this division of accounts, so the ambiguity must currently be resolved on a case-by-case basis between banks and supervisors. Importantly, banks have clear incentives to consider as large a share as possible of their business deposit balances to be operational. This is because operational deposits are considered to be more stable, meaning they have a lower assumed run off rate against which they need to hold liquid assets. The most extreme example is in the LCR rule, for insured deposits held at the bank by another financial institution. If the deposit is operational, the assumed 30-day run off rate is 5%; if it is non-operational, the assumed run off rate is 100%. Admittedly, this is by far the widest range implied by the operational deposit ambiguity, but it serves to make the point that the ambiguity matters in some circumstances.

Our analysis quantifies the impact of these ambiguities by considering both extremes in the answers to both ambiguities. To address the ambiguity related to the consideration of all depositors or only extant depositors, we measure observed run off at our bank both ways. This produces two series for observed LCR run off rates, and also two for the NSFR. One series fixes the set of depositors at the bank as of the calculation date and compares the balances held by those depositors at the beginning and end of the calculation period. We refer to these estimates as "extant depositors only" estimates. We also construct "all depositors" series, which simply reflects the runoff rate observed in aggregate deposit balances over the calculation period, irrespective of who the depositors are.

To address the second ambiguity, we present a range of run off rates which are potentially consistent with the LCR and NSFR rules. We begin by coding all deposits according to which run off rate category they correspond to in each rule.[19] The lower end of the range is constructed assuming that all deposits which might possibly be operational in fact are. The upper end of the range assumes all such deposits are not operational. Of course, these

[19]Categories are generally defined by the nature of the depositor (e.g., natural person, non-financial corporate, etc.), the type of account (checking, term, etc.), the maturity date of the deposit, the purpose of the deposit (particularly whether or not it is operational), and whether or not it is a brokered deposit.

are both implausible extremes, but they are an informative bounding exercise; if we find the bank's run off rates still exceeded those allowable under this range even if we assume the most severe runoff cases in the rules, the rules are insufficiently conservative in runoff assumptions. We only present the aggregated runoff rates for the bank. We construct run off rates at the category level, but presenting them all individually contains too much noise to improve the analysis here.

As a last remark before showing results, note that we assume that all term deposits mature within the calculation period. Under the rules, term accounts are considered to mature at the earliest possible date that the depositor is allowed to withdraw the deposit without suffering monetary penalties materially greater than earned interest. As noted previously, very few of the CDs which we observe breaking before maturity were charged withdrawal penalties in excess of earned interest. Among the few dozen accounts which were assessed higher penalties, most penalties did not exceed earned interest by more than 1% of the principal balance. The largest penalty, as a share of principal balance, was about 2%. Moreover, the vast majority of these larger early withdrawal penalties were assessed by the bank, but promptly reversed and credited back to the depositor. Thus, we argue that all of the bank's term deposits were effectively breakable with low penalties. This assumption also biases the results against us, in the sense that by assuming the LCR and NSFR rules say these accounts should be assumed to run, the rule-consistent aggregate runoff rates are higher. Thus, we are less likely to find that the bank's observed run off rates exceeded those allowed by the rules.

Turning to the results, we do not find evidence that the LCR run off rates are too low. In that sense, this analysis suggests the LCR is sufficiently conservative. The results are shown in Figure 9, where net declines in deposit balances (aggregate run off) are represented with positive values and increases in deposit balances (aggregate run in) are negative. At no point does the observed run off exceed the maximum value of the LCR-consistent range, though it comes fairly close in 2008. In that period, for some allocations of business deposits between operational and non-operational categories, the bank's run off would have exceeded the allowable rate. But without additional information on the bank's operational deposits, we cannot say that the runoff assumptions are incorrect.

In contrast, we find evidence that the NSFR run off rates may be too low, at least if the intent of the rule was to ensure resilience in the face of severe stress (Figure 10). Run off in the period around the financial crisis and in the period leading up to bank failure exceeds the NSFR-consistent range. In the latter case, this occurs only if one assumes the relevant comparison is with only extant depositors. Allowing new depositors to offset exiting deposits brings observed run off rates back below the thresholds. During the crisis, however, both measures of run off exceed the range. Unsurprisingly, the extant depositors series breaches the range by more and for longer as it does not allow new depositors to replace them at the bank.

Finally, we repeat that these results should be interpreted with some caution. The bank we study would not be subject to the rules even if it still existed; it was too small to be covered by the rules, and larger banks may differ structurally and experience different runoff rates. Additionally, it is only a single bank, and more detailed studies may give better insights into the runoff experienced by banks as a whole.

6 Conclusion

In this paper we use a novel and highly granular, unique dataset to shed light on the stability of deposit funding. We have a number of results that are important for both academicians and policy makers.

First, we are able to investigate whether government insurance programs, on which much faith is placed, affects deposit stability. We find that FDIC insurance is important and effective in making deposits more stable, with FDIC insured accounts much less likely to flee from the bank.

Second, we find that TAG and DFA-related guarantees were also effective in increasing deposit stability. The impacts of those interventions on deposit account liquidation probability are statistically and economically significant, and they are of similar magnitude to the impact of deposit insurance. Our results suggest that the programs achieved their stated goal — to increase financial stability in a time of severe stress — in spite of the fact that the programs were institutionally new and thus carried with them many operational uncertainties.

Third, we show that checking accounts are a more stable source of funding than savings accounts, consistent with assumptions in several Basel III proposals. This result likely reflects the non-pecuniary benefits of such accounts and costs to moving such accounts between banks; checking accounts are frequently used to conveniently automate transactions, both credits and debits, and switching these automated features is costly in terms of time and effort. Hence, such accounts are relatively sticky.

Fourth, we find that while the US and Basel LCR runoff rates appear appropriate, the Basel NSFR rates may be insufficient for times of stress. Of course, some caution is warranted in interpreting the results from a single small bank. Nonetheless, the present paper is rare in that it can directly assess deposit runoff in a manner similar to how banks might actually measure and experience it. The fact that we find the NSFR rates to be similar to or generally lower than rates actually experienced by our bank suggests the need for additional analysis.

Last, but not least, we document evidence that banks are able to largely undo any disciplining effect of uninsured depositors. Market discipline of banks is considered to be one of three pillars of financial stability by the Basel Committee and developed country supervisors, and economists generally believe that this is a good reason to allow banks to carry uninsured deposits. However, because the FDIC bears the credit risk of insured deposits, banks can attract insured deposits to replace uninsured depositors as they leave. This is particularly true since such troubled banks can pay above-market interest rates. We show that the bank we study was quite effective in using this method to offset deposit runoff and perhaps to its delay failure, calling into question the efficacy of market discipline as a tool for financial stability.

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Table 1: Summary Statistics for New Depositors, by Period

	Placebo	Pre-Crisis	Post-Crisis	Formal
Number of Accounts	2942	739	952	2664
Over FDIC Limit at Start of Account	0.048	0.027	0.014	0.013
Starting Balance	30038	39230	68255	168201
Oldest account is CD	0.433	0.424	0.395	0.773
Oldest account is Savings	0.509	0.433	0.415	0.107
Oldest account is Checking	0.058	0.143	0.190	0.120
Starting Interest Rate	4.616	3.875	1.486	1.096
Average Interest Rate	4.678	3.855	1.490	1.094
Starting Interest Spread	2.836	2.152	0.817	0.636
Average Interest Spread	2.752	2.137	0.888	0.658
Daily Withdrawal Amount	-90.82	-355.3	-936.80	-995.40
Daily Deposit Amount	418	1123	2481	1763
Daily Number of Withdrawals	0.013	.015	.052	0.053
Daily Number of Deposits	0.026	0.040	0.040	0.023
Number of Days with Withdrawals	0.008	.011	0.022	0.024
Number of Days with Deposits	0.022	0.031	0.030	0.016
Types of Account At Bank	1.097	1.064	1.066	1.021
Loan Linkage	0.008	0.027	0.035	0.003
Institutional	0.043	0.169	0.263	0.790
Placed	0.010	0.015	0.216	0.009
Checking and over FDIC Limit	0.009	0.003	0.005	0.002

This table shows summary statistics across all new depositors opening accounts in each of the five event periods. Depositors who already had an account at the bank at the beginning of each period are excluded. All statistics are calculated within the relevant event period and exclude all other days.

Table 2: Summary Statistics for Extant Depositors, by Period

	Placebo	Pre-Crisis	Post-Crisis	Formal
Number of Accounts	42206	46336	38930	31654
Over FDIC Limit at Start of Account	.0854	0.098	0.013	0.022
Starting Balance	27834	27479	32059	45920
CD	0.195	0.256	0.226	0.131
Savings	0.728	0.676	0.694	0.761
Checking	0.077	0.068	0.080	0.108
Starting Interest Rate	4.093	4.372	2.484	0.779
Average Interest Rate	4.210	4.247	1.760	0.876
Starting Interest Spread	2.979	3.089	1.763	0.554
Average Interest Spread	3.034	3.058	1.250	0.693
Daily Withdrawal Amount	-166.30	-171.9	-215.0	-303.1
Daily Deposit Amount	157.90	159.20	213.90	252.60
Daily Number of Withdrawals	0.038	.035	.040	0.056
Daily Number of Deposits	0.018	0.017	0.016	0.020
Number of Days with Withdrawals	0.024	0.021	0.022	0.029
Number of Days with Deposits	0.016	0.015	0.014	0.016
Types of Account At Bank	1.310	1.315	1.306	1.280
Loan Linkage	0.021	0.023	0.02	0.035
Age of Relationship in Years	2.230	3.090	4.215	5.600
Institutional	0.035	0.016	0.028	0.045
Placed	0.052	0.016	0.047	0.045
Direct Deposit	0.027	0.029	0.023	0.034
Checking and over FDIC Limit	0.007	0.009	.004	0.008

This table shows summary statistics across all extant depositors that had accounts at the start of the five event periods. All statistics are calculated within the relevant event period and exclude all other days.

Table 3: Who Withdraws? Placebo Period; Non-Maturity Deposits

	Cox P.H.	*LPM*	*Probit*
	(1)	(2)	(3)
Over FDIC Limit	1.160***	0.0350***	0.0355***
	(2.89)	(2.79)	(2.83)
Over FDIC Limit × Checking	1.086	0.000174	0.00959
(Will later be Covered by TAG/DFA)	(0.63)	(0.01)	(0.32)
Checking	0.550***	−0.133***	−0.119***
	(−9.21)	(−11.44)	(−11.79)
Recurring Deposits	0.705***	−0.0872***	−0.0782***
	(−4.64)	(−5.32)	(−5.54)
Log(Age)	0.994	−0.00631**	−0.00426
	(−0.56)	(−2.09)	(−1.53)
Prior Transactions	1.081***	0.0163***	0.0168***
	(20.18)	(22.27)	(20.08)
Prior Transactions^2	0.999***	−0.000245***	−0.000265***
	(−11.70)	(−18.49)	(−13.33)
Institutional	0.830	−0.0328	−0.0373
	(−1.52)	(−1.31)	(−1.49)
Branch Controls	Yes	Yes	Yes
N	6149602	33958	33958
R^2		0.022	
Psuedo R^2	0.004		0.019
Model Significance	9.01e-204	3.21e-169	2.54e-164
No. of Liquidations	8933	8933	8933

This table shows estimates from Cox proportional hazard, linear probability, and probit models for the probability of account liquidation during the placebo period, well before the financial crisis. Liquidation is defined as withdrawing 50% or more of the account balance and remaining below that level for 60 days or more. Cox estimates are expressed as hazard ratios, LPM estimates are OLS coefficient estimates, and Probit estimates are marginal effects. T-statistics are in parentheses. Estimates significant at 99% are denoted with ***, 95% with **, and 90% with *.

Table 4: Who Withdraws? Pre-Crisis Period; Non-Maturity Deposits

	Cox P.H. (1)	*LPM* (2)	*Probit* (3)	*Difference vs. Placebo* (4)
Over FDIC Limit	1.076*	0.0299**	0.0298**	
	(1.89)	(2.43)	(2.42)	
Over FDIC Limit × Checking	1.159	0.0341	0.0465	
(Will later be Covered by TAG/DFA)	(1.48)	(1.19)	(1.53)	
Checking	0.629***	−0.144***	−0.136***	
	(−8.93)	(−11.24)	(−11.31)	
Recurring Deposits	0.664***	−0.117***	−0.112***	
	(−6.62)	(−6.92)	(−7.19)	
Log(Age)	0.985	−0.00343	−0.00267	
	(−1.09)	(−0.79)	(−0.62)	
Prior Transactions	1.066***	0.0162***	0.0172***	
	(19.18)	(18.02)	(16.70)	
Prior Transactions^2	0.999***	−0.000283***	−0.000316***	
	(−13.56)	(−16.69)	(−13.01)	
Institutional	1.061	0.0181	0.0185	†
	(0.65)	(0.73)	(0.70)	
Branch Controls	Yes	Yes	Yes	
N	9898882	34480	34480	
R^2		0.014		
Psuedo R^2	0.002		0.011	
Model Significance	4.46e-92	2.19e-99	3.44e-77	
No. of Liquidations	12961	12961	12961	

This table shows estimates from Cox proportional hazard, linear probability, and probit models for the probability of account liquidation during the pre-crisis period. Liquidation is defined as withdrawing 50% or more of the account balance and remaining below that level for 60 days or more. Cox estimates are expressed as hazard ratios, LPM estimates are OLS coefficient estimates, and Probit estimates are marginal effects. T-statistics are in parentheses. Estimates significant at 99% are denoted with ***, 95% with **, and 90% with *. Column (4) indicates whether the hazard rate for the Cox model (in column (1)) is statistically different from the corresponding estimate in the pre-crisis period. Differences significant at the 5% level are represented by †† and 10% by †.

Table 5: Who Withdraws? Post-Crisis Period; Non-Maturity Deposits

	Cox P.H. (1)	*LPM* (2)	*Probit* (3)	*Difference vs. Placebo* (4)
Over FDIC Limit	1.480**	0.0792**	0.0734*	
	(2.35)	(2.03)	(1.96)	
Covered by TAG/DFA	0.664*	−0.0842	−0.0589*	†
	(−1.69)	(−1.63)	(−1.65)	
Checking	0.719***	−0.0593***	−0.0524***	††
	(−4.67)	(−5.10)	(−5.21)	
Recurring Deposits	0.499***	−0.116***	−0.0997***	††
	(−6.54)	(−7.66)	(−9.03)	
Log(Age)	0.987	−0.000833	0.000161	
	(−0.53)	(−0.19)	(0.04)	
Prior Transactions	1.062***	0.0101***	0.0102***	††
	(12.97)	(12.96)	(12.73)	
Prior Transactions^2	0.999***	−0.000161***	−0.000172***	†
	(−8.96)	(−11.90)	(−9.85)	
Institutional	1.098	0.0204	0.0184	†
	(0.96)	(1.10)	(0.99)	
Branch Controls	Yes	Yes	Yes	
N	4836704	30118	30118	
R^2		0.008		
Psuedo R^2	0.002		0.008	
Model Significance	4.61e-44	1.62e-40	2.72e-37	
No. of Liquidations	5842	5842	5842	

This table shows estimates from Cox proportional hazard, linear probability, and probit models for the probability of account liquidation during the post-crisis period. Liquidation is defined as withdrawing 50% or more of the account balance and remaining below that level for 60 days or more. Cox estimates are expressed as hazard ratios, LPM estimates are OLS coefficient estimates, and Probit estimates are marginal effects. T-statistics are in parentheses. Estimates significant at 99% are denoted with ***, 95% with **, and 90% with *. Column (4) indicates whether the hazard rate for the Cox model (in column (1)) is statistically different from the corresponding estimate in the pre-crisis period. Differences significant at the 5% level are represented by †† and 10% by †.

Table 6: Who Withdraws? Formal Enforcement Action; Non-Maturity Deposits

	Cox P.H. (1)	*LPM* (2)	*Probit* (3)	*Difference vs. Placebo* (4)
Over FDIC Limit	1.712***	0.200***	0.199***	††
	(8.13)	(8.34)	(7.84)	
Covered by DFA	0.859	−0.0499	−0.0413	
(TAG excluded, due to its ending)	(−0.98)	(−0.86)	(−0.83)	
Checking	0.742***	−0.0880***	−0.0842***	††
	(−6.09)	(−6.95)	(−7.25)	
Recurring Deposits	0.724***	−0.0671***	−0.0689***	
	(−4.13)	(−3.62)	(−3.93)	
Log(Age)	0.945***	−0.0125**	−0.0121**	††
	(−3.05)	(−2.19)	(−2.19)	
Prior Transactions	1.025***	0.00731***	0.00736***	††
	(6.53)	(7.60)	(7.36)	
Prior Transactions^2	0.999***	−0.000130***	−0.000134***	††
	(−6.29)	(−7.83)	(−7.05)	
Institutional	0.940	−0.0175	−0.0170	
	(−1.00)	(−0.93)	(−0.97)	
Branch Controls	Yes	Yes	Yes	
N	8646084	27523	27523	
R^2		0.018		
Psuedo R^2	0.002		0.013	
Model Significance	2.96e-78	1.25e-82	2.15e-74	
No. of Liquidations	8783	8783	8783	

This table shows estimates from Cox proportional hazard, linear probability, and probit models for the probability of account liquidation in response to the formal enforcement action. Liquidation is defined as withdrawing 50% or more of the account balance and remaining below that level for 60 days or more. Cox estimates are expressed as hazard ratios, LPM estimates are OLS coefficient estimates, and Probit estimates are marginal effects. T-statistics are in parentheses. Estimates significant at 99% are denoted with ***, 95% with **, and 90% with *. Column (4) indicates whether the hazard rate for the Cox model (in column (1)) is statistically different from the corresponding estimate in the pre-crisis period. Differences significant at the 5% level are represented by †† and 10% by †.

Table 7: Who Withdraws? Placebo Period; Term Deposits

	Cox P.H.	*LPM*	*Probit*
	(1)	(2)	(3)
Over FDIC Limit	1.033	0.0145	0.0168
	(0.45)	(0.88)	(0.96)
Log(Age)	0.980	−0.00880*	−0.00964*
	(−0.89)	(−1.70)	(−1.74)
Log(Days to Maturity)	0.641***	−0.134***	−0.141***
	(−11.37)	(−12.64)	(−11.49)
Placed	2.981***	0.210***	0.231***
	(12.05)	(6.62)	(6.27)
Institutional	1.547*	0.0663	0.0717
	(1.86)	(1.48)	(1.28)
Branch Controls	Yes	Yes	Yes
N	1182337	6547	6546
R^2		0.095	
Psuedo R^2	0.020		0.078
Model Significance	7.05e-33		5.95e-28
No. of Liquidations	1865	1865	1865

This table shows estimates from Cox proportional hazard, linear probability, and probit models for the probability of account liquidation during the placebo period, well before the financial crisis. Liquidation is defined as withdrawing 50% or more of the account balance and remaining below that level for 60 days or more. Cox estimates are expressed as hazard ratios, LPM estimates are OLS coefficient estimates, and Probit estimates are marginal effects. T-statistics are in parentheses. Estimates significant at 99% are denoted with ***, 95% with **, and 90% with *.

Table 8: Who Withdraws? Pre-Crisis Period; Term Deposits

	Cox P.H. (1)	*LPM* (2)	*Probit* (3)	*Difference vs. Placebo* (4)
Over FDIC Limit	1.216***	0.0580***	0.0588***	†
	(4.48)	(4.05)	(4.12)	
Log(Age)	0.934***	−0.0401***	−0.0414***	†
	(−5.86)	(−8.38)	(−7.85)	
Log(Days to Maturity)	0.783***	−0.0600***	−0.0632***	††
	(−10.83)	(−13.82)	(−11.61)	
Placed	3.035***	0.178***	0.198***	
	(7.66)	(6.12)	(5.74)	
Institutional	1.697***	0.0755	0.0788*	
	(3.22)	(1.59)	(1.72)	
Branch Controls	Yes	Yes	Yes	
N	2487723	10439	10437	
R^2		0.048		
Psuedo R^2	0.009		0.040	
Model Significance	6.99e-27	0	3.64e-31	
No. of Liquidations	5750	5750	5750	

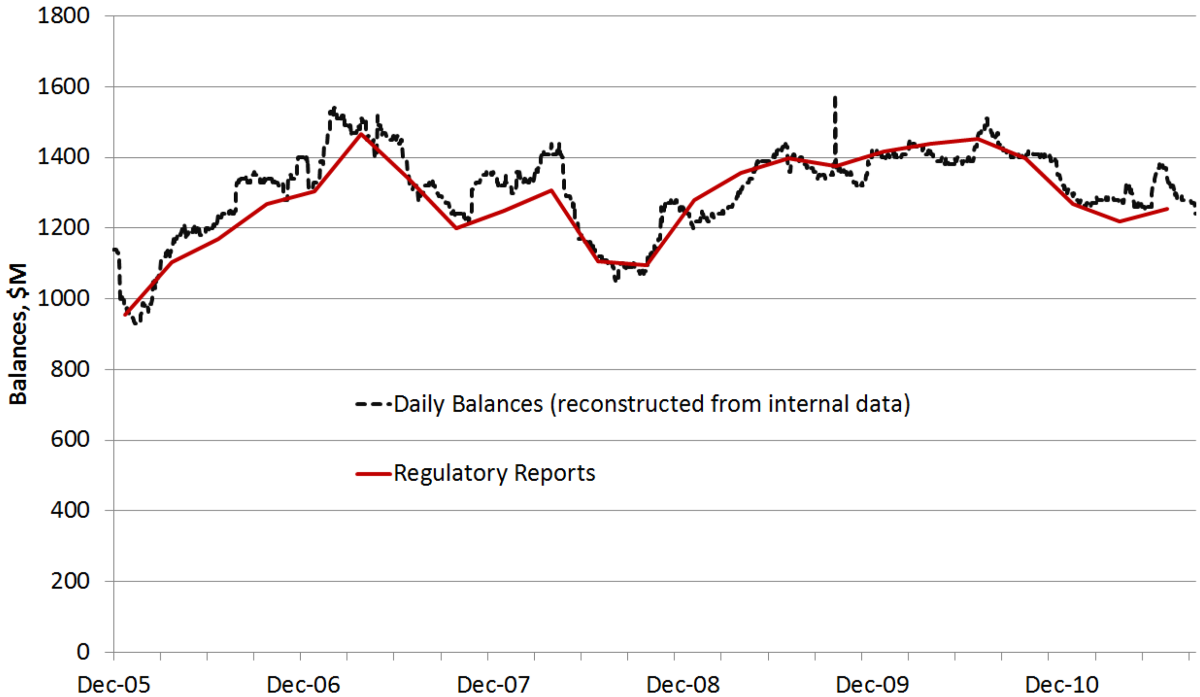
This table shows estimates from Cox proportional hazard, linear probability, and probit models for the probability of account liquidation during the pre-crisis period. Liquidation is defined as withdrawing 50% or more of the account balance and remaining below that level for 60 days or more. Cox estimates are expressed as hazard ratios, LPM estimates are OLS coefficient estimates, and Probit estimates are marginal effects. T-statistics are in parentheses. Estimates significant at 99% are denoted with ***, 95% with **, and 90% with *. Column (4) indicates whether the hazard rate for the Cox model (in column (1)) is statistically different from the corresponding estimate in the pre-crisis period. Differences significant at the 5% level are represented by †† and 10% by †.

Table 9: Who Withdraws? Post-Crisis Period; Term Deposits

	Cox P.H. (1)	*LPM* (2)	*Probit* (3)	*Difference vs. Placebo* (4)
Over FDIC Limit	1.766**	0.0632	0.0820	††
	(2.50)	(1.51)	(1.50)	
Log(Age)	0.949	−0.00193	−0.00214	
	(−1.47)	(−0.47)	(−0.37)	
Log(Days to Maturity)	0.470***	−0.194***	−0.210***	††
	(−11.13)	(−19.46)	(−17.27)	
Placed	5.543***	0.282***	0.342***	††
	(10.55)	(9.51)	(9.86)	
Institutional	0.748	−0.00399	−0.0488	†
	(−0.93)	(−0.13)	(−1.04)	
Branch Controls	Yes	Yes	Yes	
N	1263007	8328	8328	
R^2		0.311		
Psuedo R^2	0.077		0.269	
Model Significance	9.88e-36	9.21e-169	4.34e-112	
No. of Liquidations	2251	2251	2251	

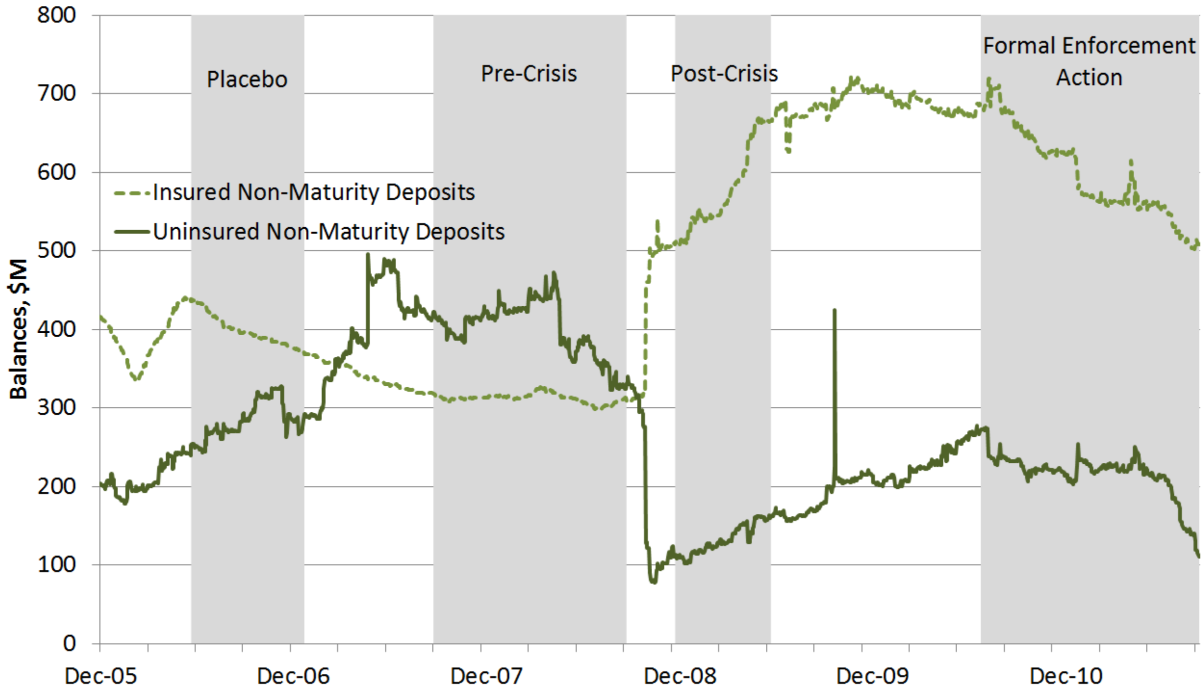
This table shows estimates from Cox proportional hazard, linear probability, and probit models for the probability of account liquidation during the post-crisis period. Liquidation is defined as withdrawing 50% or more of the account balance and remaining below that level for 60 days or more. Cox estimates are expressed as hazard ratios, LPM estimates are OLS coefficient estimates, and Probit estimates are marginal effects. T-statistics are in parentheses. Estimates significant at 99% are denoted with ***, 95% with **, and 90% with *. Column (4) indicates whether the hazard rate for the Cox model (in column (1)) is statistically different from the corresponding estimate in the pre-crisis period. Differences significant at the 5% level are represented by †† and 10% by †.

Figure 1: Total Deposit Balances



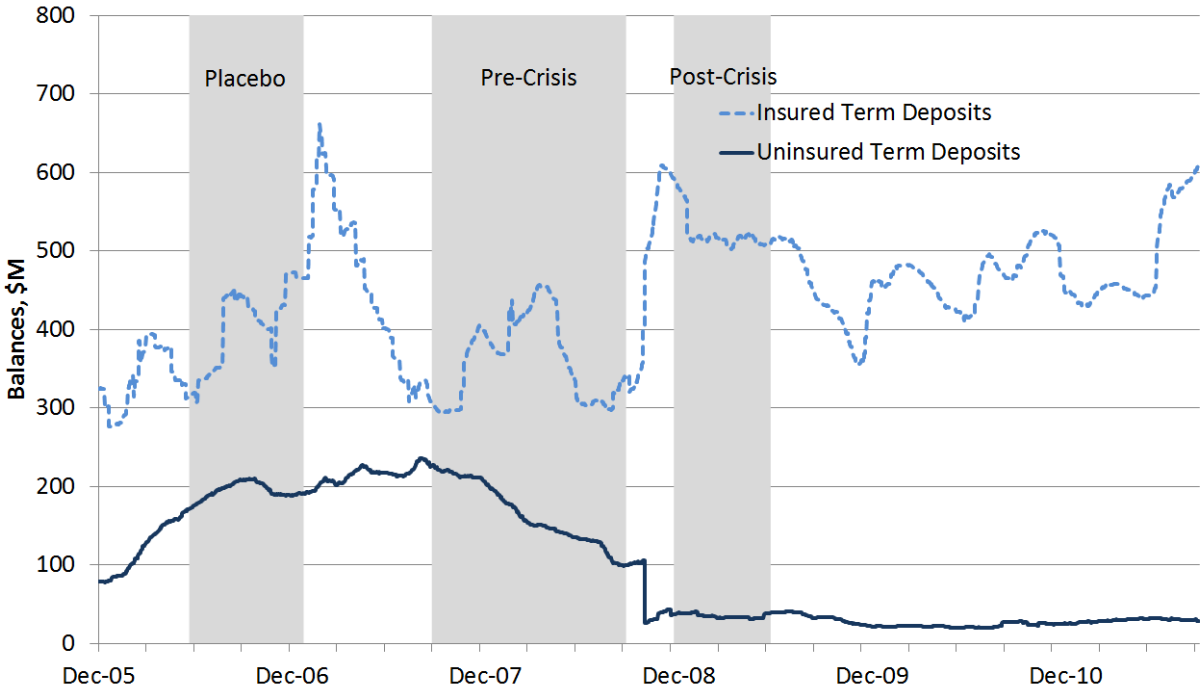
This figure shows total deposit balances at the bank for the approximately six years before its failure. The dotted blue line is the total daily account balance from our calculations on the internal bank data. The solid red line is the corresponding end-of-quarter totals taken from regulatory filings. The brief spike around 700 days before failure is related to a single transaction in which an affiliated institution passed funds through the bank in a manner which resulted in them remaining within the bank overnight for one night.

Figure 2: Non-Maturity Deposit Balances



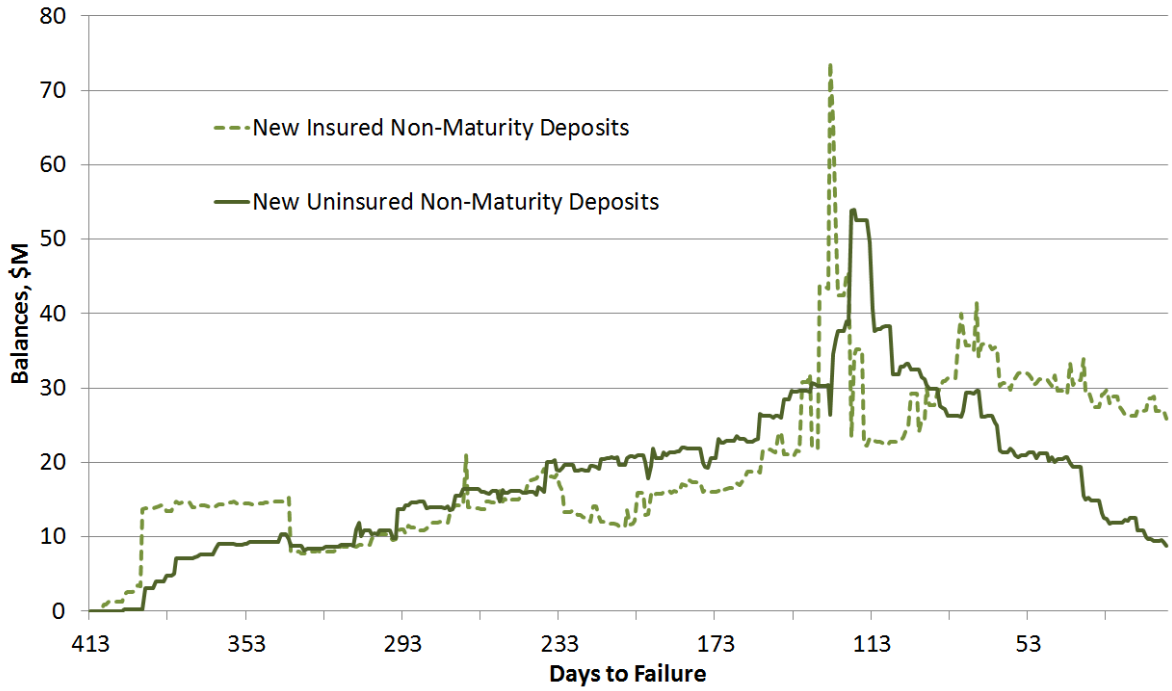
This figure shows total balances in non-maturity deposit accounts. The dotted light green line shows those deposits which were fully insured, while the solid dark green line shows total balances in less-than-fully insured accounts. Grey bars denote the time periods analyzed in the regressions of Section 4 and overlaid text identifies the name of each period. Note that the dramatic, brief spike in uninsured deposits between the Post-Crisis and Formal periods reflects a single transaction in which another subsidiary of the bank's holding company passed funds through the bank in such a manner that they remained within the bank for a few days.

Figure 3: Term Deposit Balances



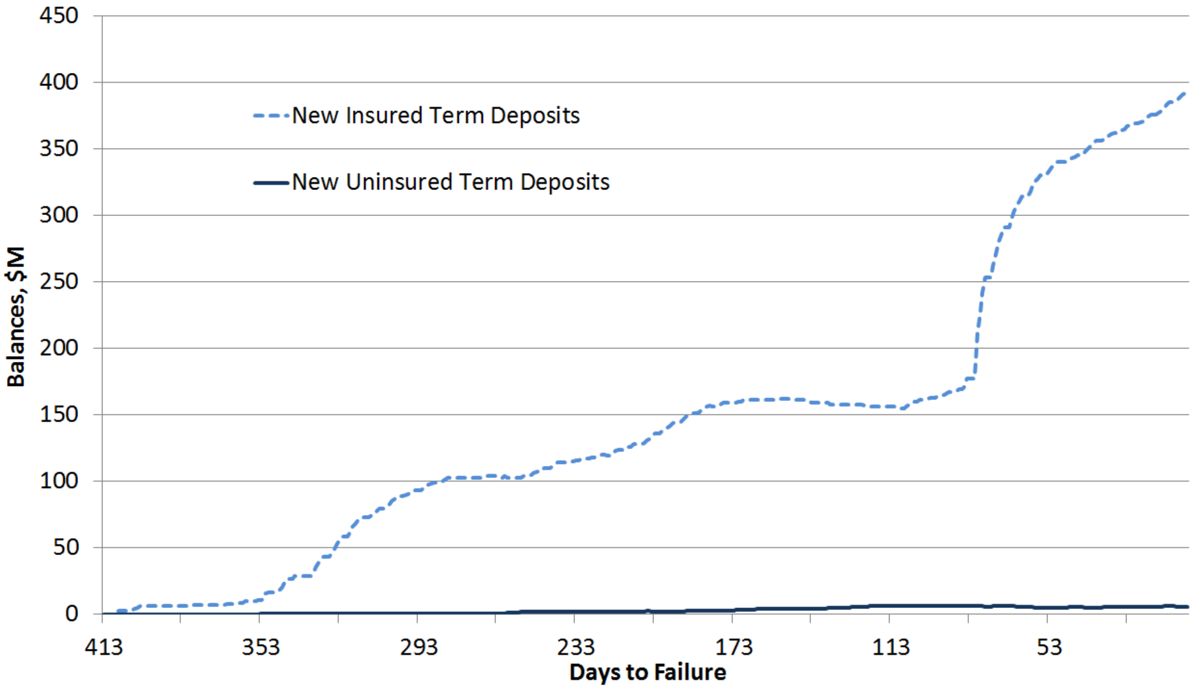
This figure shows total balances in term deposit accounts. The dotted light green line shows those deposits which were fully insured, while the solid dark green line shows total balances in less-than-fully insured accounts. Grey bars denote the time periods analyzed in the regressions of Section 4 and overlaid text identifies the name of each period.

Figure 4: Non-Maturity Deposit Balances From New Depositors



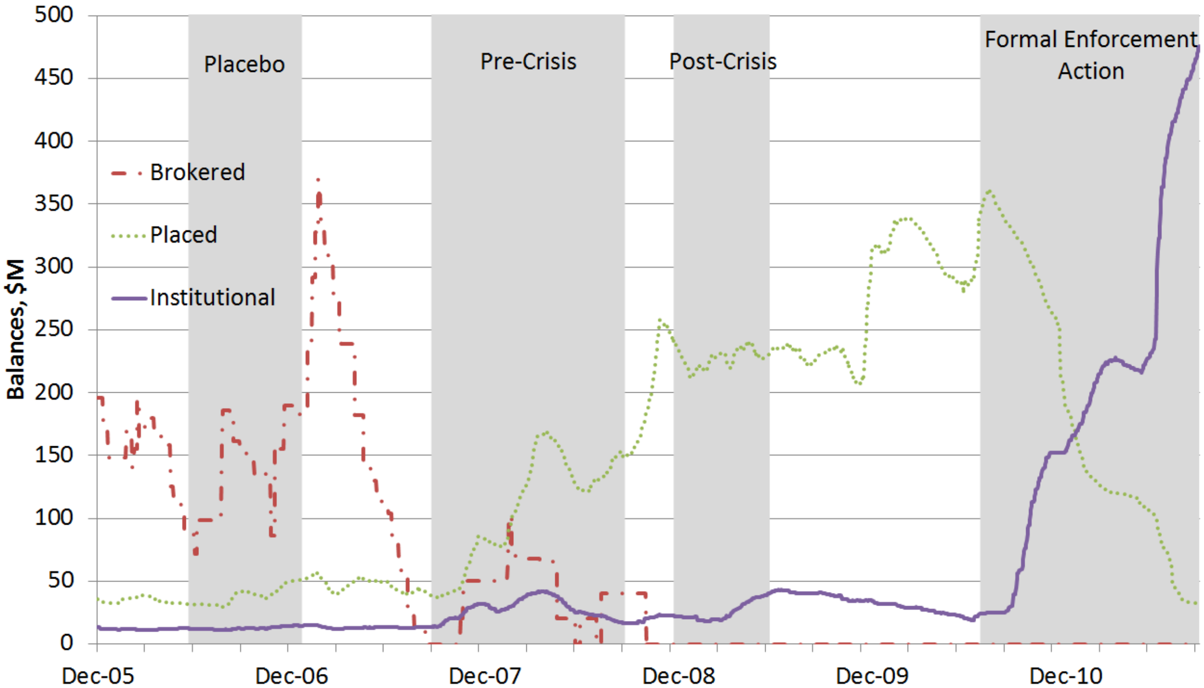
This figure shows balances in non-maturity deposit accounts from depositors who opened their first deposit account with the bank after the formal enforcement action — new depositors. The dotted light green line shows those deposits which were fully insured, while the solid dark green line shows total balances in less-than-fully insured accounts.

Figure 5: Term Deposit Balances From New Depositors



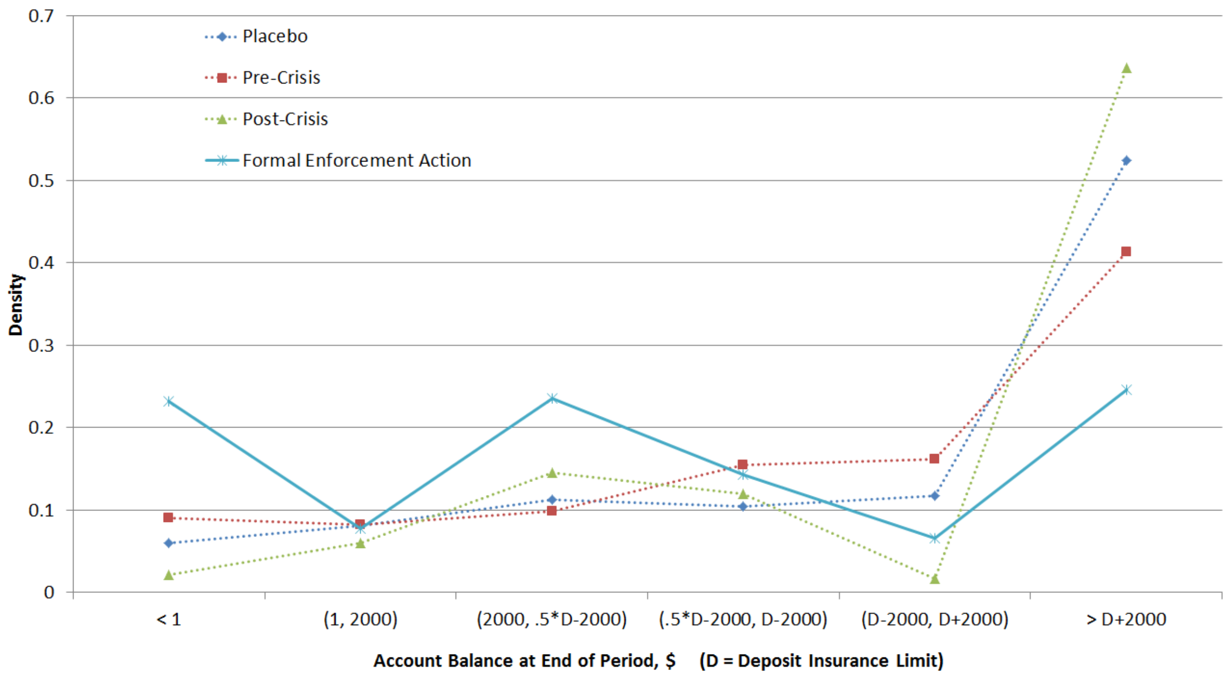
This figure shows balances in term deposit accounts from depositors who opened their first deposit account with the bank after the formal enforcement action — new depositors. The dotted light blue line shows those deposits which were fully insured, while the solid dark blue line shows total balances in less-than-fully insured accounts.

Figure 6: Term Deposit Balances in Brokered, Placed, and Institutional Accounts



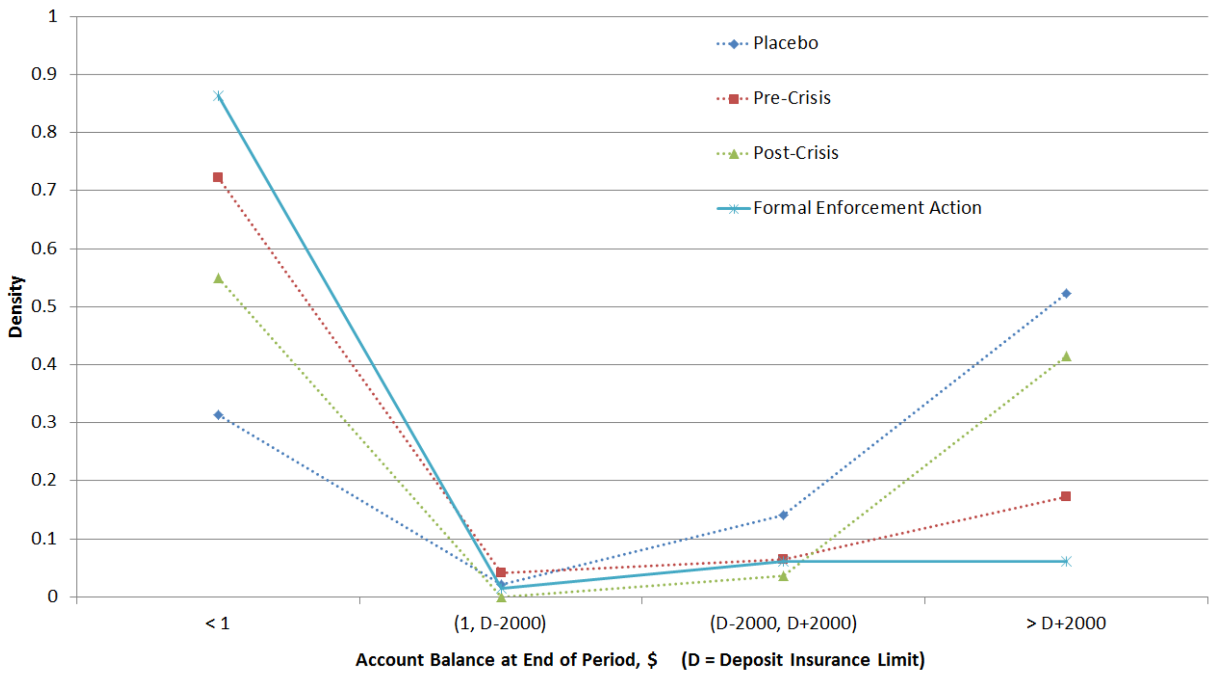
This figure shows term deposit account balances in brokered (dash-dotted red), placed (dotted green), and institutional (solid blue) accounts. Placed deposits are non-brokered deposits placed by a financial institution on behalf of a third party. The third party is generally not identified to the bank accepting the deposit. Institutional deposits are all non-brokered, non-placed deposits owned by banks, savings & loan associations, credit unions, other business/corporate entities, and municipalities. Grey bars denote the time periods analyzed in the regressions of Section 4 and overlaid text identifies the name of each period.

Figure 7: Uninsured Non-Maturity Deposit Migration



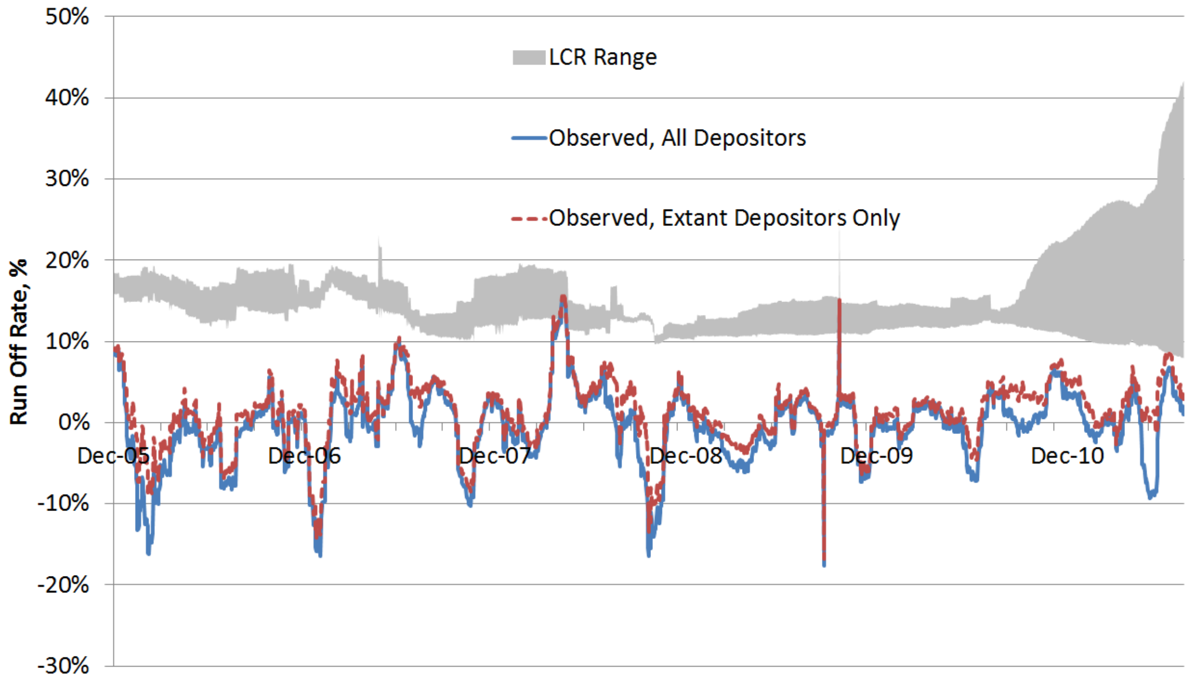
For each of the four periods studied, this figure shows the ending balances in non-maturity deposit accounts which were above the insurance limit as of the beginning of the respective period.

Figure 8: Uninsured Term Deposit Migration



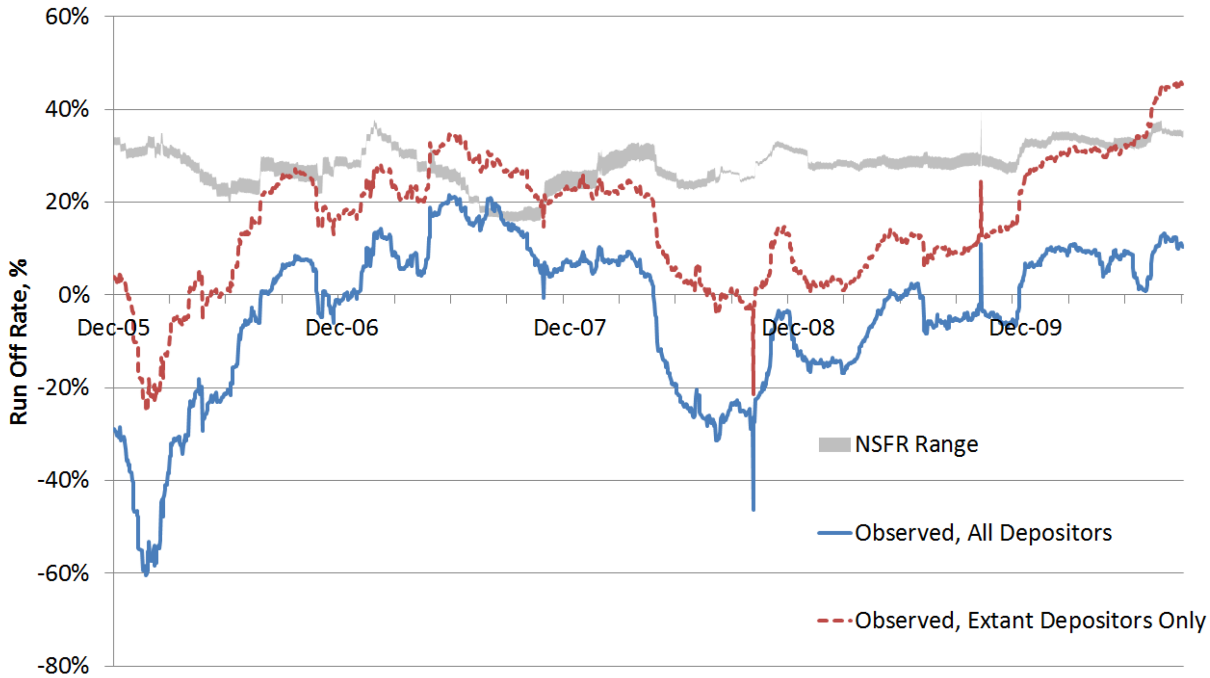
For each of the four periods studied, this figure shows the ending balances in term deposit accounts which were above the insurance limit as of the beginning of the respective period.

Figure 9: LCR Comparison



This figure shows the range of run off rates consistent with LCR (grey interval), where the range arises from uncertainty as to the share of business deposits which are considered operational. The extremes of the interval correspond to the parameterizations wherein either all or no business deposits are operational. The solid blue and dotted red lines show observed 30-day run off considering all depositors and only depositors who were at the bank as of the calculation date. All run off rates are calculated in a forward-looking manner. That is, at any given date, the plotted values correspond to run off observed over the following 30 days.

Figure 10: NSFR Comparison



This figure shows the range of run off rates consistent with NSFR (grey interval), where the range arises from uncertainty as to the share of business deposits which are considered operational. The extremes of the interval correspond to the parameterizations wherein either all or no business deposits are operational. The solid blue and dotted red lines show observed 365-day run off considering all depositors and only depositors who were at the bank as of the calculation date. All run off rates are calculated in a forward-looking manner. That is, at any given date, the plotted values correspond to run off observed over the following 365 days.