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 depositor behavior in distressed banks. Our unique data allow us to observe daily, account-level balances in all deposit accounts at the bank to examine the effectiveness of deposit insurance (both regular and temporary measures), and other account characteristics that affect deposit stability, as well as the importance of deposit inflows in distressed banks. We find, faced with bad regulatory news, uninsured depositors flee the bank. 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. Further, we find older accounts are less prone to leave in the face of bad news, and, consistent with assumptions in Basel III, checking accounts are more stable than savings accounts. However, contrary to conventional wisdom, term deposits are more risk-sensitive than transaction accounts. Our evidence also suggests 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 there was simultaneously a *run-in* at the bank with a substantial inflow of new insured deposits. Effectively, the bank was able to offset losses of uninsured deposits with new insured deposits remarkably well as it approached failure, raising questions on the effectiveness of depositor discipline widely considered to be one of the key pillars of financial stability.

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

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1 Introduction

There were many bank failures during and after the financial crisis of 2007-2009. 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 quantities 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 limit 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 such program 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. 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 Banking Supervision ("Basel Committee"). These require that banks maintain adequate "stability-adjusted" funding consistent with their "liquidity-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.

More generally, the financial crisis has motivated broad academic and policy-maker interest in the funding stability of financial institutions, especially those experiencing some form of distress. For instance, which creditors flee first? How stable are wholesale deposits? How do banks manage their liabilities during periods of stress and depositor withdrawals? Yet again, the empirical evidence on these important questions is scarce.

This paper provides evidence on the effectiveness of deposit insurance (both permanent and temporary measures), and the importance of other account characteristics in assessing deposit funding stability using a novel 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 balances and attributes 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 larger 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 deteriorated thereafter.

[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."

Using these data, we shed light on the stability of deposits and assess the deposit(or) characteristics associated with deposit stability. We provide evidence on the effectiveness of regular deposit insurance as well as the TAG program. Additionally, we estimate run-off 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, in particular through the inflow of certain kinds of deposits.

Our analysis highlights a number of important points. First, term deposits at the bank we study were more risk sensitive than transaction accounts,[2] 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 and the inherently forward-looking nature of a non-demandable deposit.

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. These deposits were structured to fall just under the insurance limit; at this time the bank was offering above-market rates. The bank replaced about 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

[2] Throughout this paper, we use "term deposit" and "certificate of deposit" ("CD") as synonyms. We use the phrase "transaction account" to refer to all non-maturity accounts, namely, both checking and savings accounts. We acknowledge that the phrase "transaction account" has a more precise meaning in certain contexts, such as in the Federal Reserve's Regulation D.

ineffective. Finally, this also highlights a channel by which the bank was able to shift credit risk exposure (to the bank's own credit risk) from uninsured depositors to the FDIC just as it approached failure.

We conduct additional analysis taking advantage of our daily frequency data using Cox hazard models (in addition to probits and linear probability models). We find that FDIC insurance and other government guarantees, including temporary measures such 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. We also find that depositors who have been with the bank longer are less likely to exit, even when faced with bad regulatory news, suggesting that such depositors tend to be sticky. Our regressions also support the finding from our earlier analysis that term deposits at this bank were more risk sensitive and less "sticky" than transaction deposits.

Finally, we use our novel data to study the LCR and NSFR rules which are currently deployed around the globe. While the LCR run-off rates assumed by US supervisory agencies appear appropriately conservative, the NSFR run-off 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. Our findings of a run-in by new depositors raise important questions about LCR and NSFR. In particular we highlight 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 can reduce the effectiveness of the rules.

While this bank did see a great deal of deposit turnover, especially close to failure, it is important to note that at no point did this bank experience a run of the type described by Diamond and Dybvig (1983) or Chari and Jagannathan (1988). Nonetheless, there was a systematic outflow of deposits from the bank prior to failure. Understanding deposit dynamics in failed banks — what kind of deposits flee, what new deposits come in, and the underlying characteristics — is important to regulators and academicians alike.

The empirical literature in general finds that banks with worse fundamentals experience greater deposit withdrawals in a crisis (Gorton (1988); Saunders and Wilson (1996); Calomiris and Mason (1997)). Examining bank-level data, these withdrawals can act as a form of depositor discipline on risky banks (Park and Peristiani (1998); Billett, Garfinkel, and O'Neal (1998); Martinez-Peria and Schmukler (2001); Goldberg and Hudgins (2002)). Egan, Hortaçsu, and Matvos (2017) use structural models to show that large amount of uninsured deposits can lead to unstable banks.

A small set of papers examine responses to individual deposits to bank runs. These papers either use snapshots of data (Davenport and McDill (2006)) or data from banks in other countries such as India (Iyer and Puri (2012); Iyer, Puri, and Ryan (2016)); Denmark (Iyer, Jensen, Johannesen, and Sheridan (2016)); and Switzerland (Brown, Guin, and Morkoetter (2014)). To the best of our knowledge, ours is the first paper to use continuous, daily, account-level depositor data for a failed bank in the US, to systematically study both inflows and outflows of deposits and the underlying depositor characteristics. Our data covers a period in time when temporary deposit insurance measures such as TAG came into effect. As such, we are able to add to the literature by examining the effectiveness of both regular deposit insurance measures as well as temporary deposit insurance measures on which regulators, worldwide, have put much faith. We are also able to provide evidence on the stability of certain kinds of deposits such as term deposits, account age and kind of account held. Additionally we throw light on new, post-crisis rules such as LCR and NSFR. Last, but not least, our findings show evidence of substantial deposit inflows in times of stress, raising important questions about the effectiveness of depositor discipline.

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, highlighting a number of our key findings and providing context for our later analysis. Section 4 presents regression results; Section 5 presents results on the migration of uninsured balances in response to adverse information about the bank; and Section 6 presents our assessment of the LCR and NSFR rules in relation to the bank. Section 7 concludes.

2 Data

We construct out dataset 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. 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.

We conducted several data validation exercises to ensure the quality of our data. We compared our construction of total deposit balances, balances by major account category, and balances by branch to the bank's regulatory reports. Our data compares favorably, save for a few systematic errors which appear to be due to such known phenomena as banks' sweeping of checking account balances into non-checkable accounts.[3] We also checked individual account balances, ensuring both that accounts have zero balance before account

[3] Banks engage in such sweeps to lower their required reserves at the Federal Reserve, but the actions are not recorded in our data.

opening and after account closing, as well as that the cumulative changes in account balances over the full sample (say, from account opening to bank failure) match the sum of the transactions observed in our data. In summary, these exercises roundly support the validity of our data.

2.1 Variable Definitions

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. We define variables as follows:

- *Liquidation.* This dummy variable is used as the dependent variable in the regressions of Section 4. 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 bad news about the bank (for example, Iyer and Puri (2012) and Iyer et al. (2016b)). 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,[4] if the balance stays that low or lower for at least 2 months. It is 0 otherwise. This definition of liquidation therefore captures instances where accounts with non-zero balances cash out and close as well as instances in which depositors withdraw a substantial share of the deposit but maintain some funds at the bank. For cross-sectional models (linear probability and probit models), this variable is equal to 1 if, at any point in the measurement period, the account balance falls below 50% of the balance as measured at the beginning of the measurement period and stays that low or lower for at least 2 months.

[4]By "measurement period," we are referring to the time windows over which we run regressions. We will discuss these time periods in more detail in the next subsection.

- *Over FDIC Limit.* For any given account, 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 we flag as insured definitely have no uninsured funds in them. Accounts we flag as uninsured *should* have uninsured funds in them, but are *possibly* fully insured due to joint account and trust rules that cannot necessarily be determined using the bank's internal 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 our estimates of any effects of being over the FDIC limit towards zero, so estimates in our regressions are lower bounds on the effects of being over the FDIC insurance limit. Our choice to consider all balances in an incompletely insured account to be uninsured is partly based on the above-mentioned technical concerns around insurance determination, and is also supported by the findings of Section 5. In short, we show that in response to financial system-wide anxiety and, especially, in response to bank-specific bad news, incompletely insured depositors generally draw down their balances far *below* the insurance limit and often to zero. Thus, even most of the *insured* funds in incompletely insured accounts behave as though they are *uninsured*.

- *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-bearing demand deposit accounts, and interest on lawyers' trust accounts (IOLTAs), which comprise all categories of checking accounts at this bank. The TAG guarantees were in force from October 14, 2008 until December 31, 2010. While banks 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-bearing demand deposit accounts and IOLTA accounts, though not NOW accounts. The DFA guarantees were in force from December 31, 2010 until December 31, 2012. In regressions estimated on time periods prior to either program, we replace 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. In those regressions, the replacement dummy variable is used to establish a baseline behavior for large checking accounts, which is the same set of accounts covered by TAG subsequent to the crisis. The use of the replacement dummy variable for large checking account allows us to better disentangle the effect of being a large checking account from the effect of the temporary guarantee programs (by comparing coefficients across time periods). 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 non-interest checking accounts, NOW accounts, and IOLTAs. This definition excludes money market accounts and other savings accounts, which we collectively refer to as savings accounts. Our definition of checking accounts is constructed to agree with the definition of transaction accounts in Federal Reserve Regulation D.

- *Direct Deposit.* This dummy variable is equal to 1 if depositors are receiving a recurring direct deposit roughly every two weeks, in the form of a paycheck or a sweep from a brokerage account, for example, as of the start of the measurement period. It is 0 otherwise.

- *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 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 an existing deposit relationship. Relationship age serves as a measure of the depth of the depositor relationship. The age of the account is dated differently in the case of placed deposits; see the discussion of placed deposits below for more details.

- *Prior Transactions.* This is the proportion of days in the past year, as of the start of the measurement 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 every day.[5] This serves as another measure of depositors' relationship depth. This variable is always 0 for term accounts, which generally do not post transactions.

- *Institutional.* This dummy variable is equal to 1 if the account is owned by a bank,

[5] In calculating this variable, we exclude transactions which are exogenous to the depositor, such as routine, monthly interest credits.

credit union, financial corporate, municipality, or other corporation, or if it is a business product type as marked in the bank's records. Businesses are likely more informed about the conditions of the bank but also face higher switching costs due to the need to acquire necessary bank services.

- *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. This value only exists for term accounts. It is always 0 for transaction accounts.

- *Placed.* 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 reflect a less personal connection with the bank. 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 may 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 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 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.

2.2 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 empirical models of Section 4, we analyze depositor behavior in four windows of time. We also use these time periods to some extent in the historical analysis of Section 3, and they are presented as grey bars in Figures 1 and 2. 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 when neither the bank nor the financial system were perceived to be especially troubled. We chose the period because it is well before the crisis (necessary for a placebo) and is the earliest period for which the data are 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 the bank's deposit database systems.

- *Pre-Crisis.* The next time period we focus on is the year-long period before the financial crisis, by which we mean the year-long period ending just before September 2008. One might expect depositors to show some signs of the system-wide anxiety which was building in financial markets, and indeed they do, but there were no significant revelations of bank-specific trouble. In this period, uninsured deposits began running off, particularly uninsured term deposits. We end this period before September 2008 and intentionally exclude the crisis from the 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 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, have the potential to generate unintuitive depositor behavior and make it difficult to causally identify the effects of any given program. While the fall of 2008 is certainly an interesting episode, we do not wish to contaminate our estimates of, say, the effect of deposit insurance with such confounding factors. Clearly, the Post-Crisis period was a period of considerable distress across the financial system, which we will show was reflected at our bank. As in the Pre-Crisis period, though, there were not significant revelations of bank-specific trouble at the bank we study.

- *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 consisted of two events. First, the bank's regulator served it with a confidential Troubled Condition Letter (TCL) stating the regulator's view of the bank's troubled condition and placing a number of new restrictions and expectations on the bank. Shortly thereafter, the regulator issued a publicly announced Cease & Desist (C&D) order to expand on the earlier letter. This 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 TCL 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 for the bank. Unlike any of those earlier periods, though, the stress arose from the publication of bank-specific adverse information, rather than from system-wide anxiety, the latter having largely subsided since the crisis.

3 Historical Background: Depositor Withdrawals and Deposit Composition

This section will provide a more detailed history of the bank, both to present several of our key findings as well as to motivate later empirical results

3.1 Brief History of the Bank

Until mid-2007, this bank appeared relatively healthy. The balances in less-than-fully insured (henceforth, "uninsured") accounts, both transaction and term deposits, were steadily rising (see Figures 1 and 2). 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 the growing financial-system-wide solvency and liquidity concerns, and their indirect impact on depositors' assessment of our bank's riskiness, are evident. Between mid-2007 and August 2008, there was net run-off in uninsured balances. Figures 1 and 2 show that the run-off was particularly rapid among term deposits. While less than 40% of uninsured transaction 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 (Federal Reserve Bank of St. Louis (2011)). 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 were more reactive and ran off earlier than transaction deposits is, at first, surprising. It is particularly important given that economists often consider term deposits to be a more stable source of funding than many transaction 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 of term depositors than transaction depositors are corporate entities at our bank, and these corporate entities might be expected to manage their assets more carefully. Insured and transaction 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 transaction 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.[6] Thus, it is not surprising to find that account features that make withdrawals more difficult are associated with depositors being more careful about renewing such accounts during times of stress. 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 in which severe credit and liquidity risks were realized across the financial system, and it was also a period of 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.[7] Additionally, the FDIC's TAG program became effective on October 14, 2008, temporarily providing un-

[6]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.

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

limited deposit insurance for NOW accounts, non-interest-bearing demand deposit accounts, and IOLTAs, which comprise all categories of checking accounts at our bank. The change in deposit insurance is evident in Figures 1 and 2, where uninsured deposits drop precipitously and insured deposits jump between the Pre-Crisis and Post-Crisis periods denoted with grey bars. The bulk of that sudden change in balances by insurance status is mechanical, as deposit accounts between \$100,000 and \$250,000 suddenly became insured. A smaller portion of the change among transaction accounts also reflects the almost simultaneous application of TAG guarantees. The change in insurance status among term deposits is driven entirely by the higher, but finite, limit for all deposit accounts, as the TAG guarantees did not apply to term deposits.

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 market-wide credit and liquidity concerns, as well as their insensitivity to bank-specific adverse information, shown in Figure 2 and in unreported regressions close to bank failure, it is possible that most or all of these remaining term deposits were insured. Alternatively, survival bias may mean these remaining accounts have holders that are extremely attached to the bank. In contrast to term deposits, and reflecting their lower risk sensitivity, uninsured transaction deposits continued to accumulate, even during the remainder of the financial crisis and recession. Note that we consider TAG-covered accounts to be insured for the purposes of this discussion. Uninsured transaction deposits 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 system-wide or macroeconomic stress of the crisis had receded and the bank's health had not yet deteriorated to a critical point.

Then, a little more than 400 days 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 confidential Troubled Condition Letter (TCL) followed shortly by a published Cease and Desist (C&D) order. The C&D order was made public immediately and appeared in the local press within a couple of business days. It 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, 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, transaction depositors responded strongly to the news, with an increase in aggregate run-off. Even insured transaction deposits ran off over the period, though not nearly as rapidly as uninsured deposits. As noted above, there were few uninsured term deposits left at the bank, and so term deposits respond very little to the bank-specific bad news contained in the enforcement action publication.

Finally, three to four months before the bank failed, the banks' public regulatory filings

[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.

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

(including amendments to previously filed and published filings) began showing the bank to be "significantly undercapitalized" and, within weeks, to be "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 leverage ratio falls below 2%; that is, if they are nearly insolvent in book value terms. 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 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 1.

Ultimately, the bank failed, and its primary federal regulator concluded that its failure was a result of heavy credit losses on the loan portfolio, which was highly concentrated in exotic residential mortgage products, including adjustable rate mortgages.

3.2 Deposit Composition

Strikingly, Figure 3 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. In fact, this large inflow was sufficient to offset essentially all fleeing deposits, meaning that total deposit balances declined very little as the bank approached failure. 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.

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

The large inflows reflect an important shift in deposit composition near bank failure, which is another of our key findings. Figure 4 captures the shift. Around the time of the 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 transaction deposits were also running off, to the tune of about $350 million over the period. As placed CDs and transaction 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 on which we focus, which correspond to the grey bars in Figures 1, 2, and 4. 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 depositors' concern with the bank's credit risk, 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 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 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%). This reflects the fact that these new depositors were not retail or "core" depositors, but a form of wholesale funding. 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 (see, among others, Basel Committee (2001), Martinez-Peria and Schmukler (1999), and Park and Peristiani (1998)). 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 (Dewatripont and Tirole (1994), FDIC (1997), and FDIC (1998)). This argument is supported by the fact that, of all US banks which received a formal enforcement action between 2000 and 2012, about 54% have since failed or been acquired by another bank.[11] These failures and mergers tend to occur relatively soon after the enforcement action, with 36% occurring within the first three years after the enforcement action and the remaining 18% occurring thereafter. Considering both that we do not observe instances of external support (such as from a parent entity) for banks subject to enforcement actions and that this bank's enforcement action was particularly harsh, it seems unlikely that the bank was independently viable

[11] Acquisitions are slightly more common than failures among this sample of banks.

as of the enforcement action.[12] Nonetheless, a more optimistic view would be that inflows of insured term deposits to troubled banks are a benign event which primarily serve to preserve banks' funding and reduce the risk of liquidity failures among fundamentally solvent banks.

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 rates are 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.[13] 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

[12]The bank also tried and failed to raise capital from at least one private source during the period.

[13]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.

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 competition for bank deposits at this time.

The final reason that the shift in deposit composition is important is that the shift also served to quietly transfer risk to the FDIC. Although the fleeing placed CDs and insured transaction accounts were insured, about $150 million of uninsured transaction deposits also ran off. Because the bank was 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.[14] 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 presents the results of several different regression models to demonstrate new findings and also to formalize some of the key results from the previous section. We regress the account liquidation dummy on a variety of 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 transaction deposits, we run regressions separately on the two categories. For transaction deposits, we run the models on four separate sample periods, one for each of the

[14] Birchler (2000) makes a related point.

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 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 cannot 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 noting here. First, throughout all regression results, standard errors are clustered at the primary 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 Transaction Deposits

Focus first on transaction deposits. Tables 3, 4, 5, and 6 present the regression estimates. The regression results for transaction 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. We also show that depositors with longer relationships with the bank are more sticky, particularly in the face of adverse information about the bank. In reviewing the results, we will also see further evidence of a finding from the previous section: transaction deposits were relatively less risk-sensitive than term deposits. Transaction account regressions generally don't show evidence of depositor response to system-wide financial stability concerns 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 an earlier response; 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 large checking 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 retail deposits and either be a checking account or be held

[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.

by a depositor with other relationships with the bank (such as loans, other accounts, bill payment services, etc.).[16]

Similarly, we find that accounts which are receiving direct deposits roughly every two weeks (indicative of direct-deposited paychecks or other regular payments) 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 checking accounts should, on average, be more stable, at least partly because they are the types of accounts into which depositors might have salaries deposited (Basel Committee (2013)).

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.

Depositors with a longer relationship with the bank are more stable at least in the face of bank-specific bad news, and probably more generally. We say "probably" because although the point estimates indicate that these accounts are less likely to liquidate in all time periods, the estimates are only consistently statistically significant in the Formal period. We suspect that the lack of significance in earlier periods reflects the comparatively short average depositor relationships in those periods. The bank we study was relatively young as of the beginning of our data in 2006, such that it did not have especially long depositor relationships. As the summary statistics in Table 2 show, the average length of depositor relationship was more than twice as long in the Formal period as in the Placebo period.

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

[16]Note that our definition of "checking account" is synonymous with the definition of "transaction account" in Federal Reserve Regulation D.

occasionally transact), as opposed to forgotten accounts which never transact and liquidate relatively less often. As the frequency of transactions 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. While there are statistically significant differences in this basic result across time periods, the differences are economically small.

Finally, transaction 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 transaction deposits generally did not react much to building financial system weaknesses 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.[17] Only the Institutional dummy coefficient 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 transaction 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 than other accounts at the time and about three times as fast as uninsured accounts in the Placebo period. Of course, this impact remains statistically different from zero, just not from the comparable estimate in an earlier period.

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

Additionally, these regressions suggest that TAG guarantees were equally as effective in preventing liquidation as ordinary deposit insurance during the Post-Crisis period. This is the first period in which TAG was in place, and the coefficient estimates are statistically significantly negative (they were not statistically different from 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 magnitude in opposite directions. A Z-test of differences in the magnitudes of the coefficients fails to reject the null of no difference at with a p value of .95, indicating they are effectively the same size. Given that TAG was new and unconventional, the program and its operational details would have been unfamiliar to depositors. Thus, it is interesting to find that depositors react to it the same as regular deposit insurance.

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

Finally, in the Formal period, it is clear transaction depositors responded to the bad news about their bank (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 other accounts in the period. The fact that deposit insurance had such a large effect on liquidation behavior supports the assertion that depositors were well aware of and very concerned by the bank's critically declining health. Of course, it also shows that deposit insurance is effective in drastically improving the stability of deposits.

The result for the Covered by DFA dummy merits additional discussion. As the TAG program ended during the Formal period, its dummy must be revised for our Formal period regressions. Following its expiry, the DFA continued its unlimited insurance coverage on checking accounts and IOLTA accounts, but not NOW accounts, through 2012.[18]

Given that TAG's expiration was known in advance, we may expect depositors in NOW

[18] NOW accounts continued to benefit from ordinary deposit insurance.

accounts to liquidate balances prior to the scheduled end of their deposit guarantees. This would generate a positive relationship between NOW status and liquidation at the same time non-interest checking and IOLTA accounts may show a negative relationship. Additionally, while the Cox model includes time-varying variables, our cross-sectional LPM and probit models cannot. Given that there is important time variation in the TAG dummy, we revise the dummy to only capture accounts covered by the DFA guarantees.

We find that DFA guarantees did not statistically significantly decrease the probability of account liquidation, though the point estimates remain similar to the corresponding estimates from the Post-Crisis period. There are relatively few accounts covered by DFA guarantees which were over the regular FDIC limit, so the coefficients are estimated with less precision than in earlier periods. Alternatively, DFA guarantees may have been less effective, perhaps because depositors were not aware of them following the end of the more high-profile TAG guarantees.

4.2 Term Deposits

Next, we 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 is relatively 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 transaction deposits, and they fled the bank earlier. We again find that deposit insurance is 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 depositors were not concerned about the bank's health in the

Placebo period, consistent with our expectation. Placed CDs are statistically significantly more likely to liquidate, and they do so at a rate about three times as fast as other CDs, according to the Cox model estimates. As was true for transaction deposits, we find that the age of a depositor's relationship with the bank is negatively associated with liquidation probability.[19] 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 few term deposits were withdrawn before maturity, 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 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 likely 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. Interestingly, note that the point estimate of 70% here is the same as the point estimate for the effect of deposit insurance on transaction accounts in the later Formal Enforcement Action period. 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.

[19]Recall that age, here, means the length of the depositor's relationship with the bank, including relationships established via accounts other than the current CD account. A CD's remaining time to maturity is captured by a separate variable. Recall also that we treat the age of placed deposits differently, as discussed in Section 2.1.

5 Account Liquidation and the Withdrawal of Insured Funds

With the increased propensity of uninsured depositors to withdraw their deposits established, it remains an open question as to whether uninsured depositors concerned about the bank's health will draw down their deposits to the limit or instead draw down well below the limit. In this section, we show that when uninsured depositors withdraw funds during times of bank-specific solvency concerns, they tend to withdraw substantially more than necessary to obtain full insurance coverage. That is, they withdraw insured funds from the account in addition to uninsured funds, meaning that even insured funds can be unstable in the face of bank risk. This is an important consideration for economists concerned with financial stability and also supports our choice to code all funds in an incompletely insured account as uninsured (see Section 2.1).

Table 10 presents our results on this topic for transaction accounts.[20] Each row represents one of our four periods, and for each period we consider the set of accounts with balances \$2,000 below the insurance limit or higher at the start of the period. The columns then show balances of these accounts arranged into six different bins at the end of the period. If uninsured depositors are only drawing down to the limit under stress, we should see a large number of uninsured deposits end up in the bin within \$2000 of the deposit insurance limit (column (5)). If the depositors are instead halving accounts, emptying them entirely, or using some other rule of thumb to perform withdrawals, we should instead see larger numbers of accounts ending up in columns (1-4), well below the insurance limit. We find evidence of the latter. The largest groupings in the formal period, relative to their previous periods, are accounts with \$1 or less, or between \$2000 and \$2000 under half the insurance

[20] We do not show a comparable table for term deposits because their behavior is simpler: generally, they remain with the bank or exit entirely.

limit ($2000 to $123000, in this period), with far fewer accounts remaining above the deposit insurance limit than in any other period.

This finding is consistent with empirical findings in Davenport and McDill (2006) and Iyer et al. (2016a), and can serve to inform banking theory models (such as Davila and Goldstein (2016)).

6 Run-Off Rates Compared to Regulatory Liquidity Ratio Assumptions

As a final empirical exercise, we compare observed run-off rates at the bank to the ranges allowed in the LCR and NSFR rules which are now being applied to large banks. We show that, at least in the case of this bank, the LCR appears appropriately conservative; at no point did observed run-off at the bank unambiguously breach the LCR limits. In contrast, the NSFR does not appear sufficiently conservative in periods of high stress. Both in the period of system-wide anxiety around the crisis and after the publication of bank-specific adverse information in the year before failure, run-off rates exceeded NSFR thresholds. In addition to assessing the realism of the rules' run-off rate assumptions, we identify two significant areas of concern with respect to the rules. Because we have access to unusually granular banking data, we are able to study 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 "stability-adjusted" funding to continue funding their "liquidity-adjusted" assets in the face of funding stress, thereby reducing the risk of asset fire sales, associated externalities, and liquidity-related failures.[21] The LCR contemplates a

[21]The liquidity adjustments are made using weighting factors analogous to the risk weights used in risk-

30-day period of acute funding stress while the NSFR considers a one-year horizon, though the level of stress assumed in the latter case is not clear from the language of the rule. The aspects of the rules most 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 run-off rates (provided in the rules) to their deposits and determine if the bank is sufficiently liquid to withstand the assumed run-off. We assess these run-off rates below.[22]

As noted previously, our unique data allow us to identify and characterize two significant areas of concern. First, economists ordinarily focus on run-*off* of existing funding when considering the resilience of banks' funding structures, including in the LCR and NSFR. However, as discussed above, we find that our bank experienced both substantial run-off and run-*in*, even just before bank failure. Absent this large run-in, the bank would have breached the NSFR range more often, for longer, and by a wider margin. Importantly, both the LCR and NSFR are unclear as to how run-in should be treated. Specifically, do the run-off rates in the rules reflect deposit drawdowns among only extant depositors or are new depositors allowed to offset some of the run-off? We show this distinction is important.

The second area of concern relates to banks' incentives and opportunities to "game" the rules around 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

based capital rules. Very generally, LCR and NSFR apply the same logic to liquidity as capital regulations do to capital.

[22] 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 run-off rates assumed in the US rule as the basis for comparison. As of this writing, the 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. For more detail, see and Basel Committee (2013, 2014) and Federal Register (2014, 2016).

portion (that portion which is arguably placed at the bank for the above reasons) and a non-operational portion (implicitly, to earn interest income). Operational deposit balances are assumed to be more stable and thus have a lower assumed run-off rate. 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%. Importantly, there are not clear guidelines on how to determine the division of accounts, meaning that banks have both the incentive and the discretion to overstate the operational share of their business deposit balances. This opens the door for regulatory arbitrage, and banks' successes in gaming risk-based capital regulations suggest that supervisors should consider eliminating this area of discretion for banks.

Our analysis tests the sensitivity of the rules' stringency to these two areas of concern. First, 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. Second, to quantify the impact of bank discretion related to operational deposits, we present a range of run-off rates which are potentially consistent with the LCR and NSFR rules. 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. These are both unlikely extremes, but they constitute an informative bounding exercise. As a last remark before showing results, note that we assume that all term deposits mature within the calculation period.[23]

Turning to the results, our analysis suggests that the LCR is sufficiently conservative.

[23] "Calculation period" refers to the horizon of the stress window, 30 days and one year for LCR and NSFR, respectively. 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.

The results are shown in Figure 5, 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.

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 funding stress (Figure 6). Run-off exceeds the NSFR range both in the period of system-wide anxiety around the crisis and subsequent to the publication of bank-specific adverse information in the year before failure. 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 threshold. 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 note that these results should be interpreted with some caution. The single 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. Moreover, larger banks may experience different run-off rates due to differences in, for example, liability structure or business model.

7 Conclusion

In this paper we use a novel, highly granular, and unique dataset to shed light on deposit inflows and outflows in failing banks, and underlying characteristics which are important in assessing deposit stability. We have a number of results that are important for both academicians and policymakers.

First, we are able to investigate whether government insurance programs, in which much faith is placed, affect 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 temporary measures to increase deposit insurance, in particular TAG and DFA-related guarantees, were also effective in increasing deposit stability during times of system-wide banking stress. 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 ordinary 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, as well as 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 term deposits are more risk-averse and run off quicker than transaction accounts. This is contrary to commonly made assumptions that term deposits are stable, which is generally assumed in Basel III and by most economists. This is likely because term depositors are more sophisticated. In particular, uninsured corporate term deposits almost completely exit on signs of trouble.

Fifth, we also find that account age matters for deposit stability. When the depositor has been with the bank for a long time, even in the face of bad regulatory news, these depositors are less likely to flee the bank. While this could be because of a variety of underlying factors e.g., inertia, inattention, trust, or relationships, the stickiness of such accounts in bad times suggests it is an important source of deposit stability, and suggests that developing long-term relationships can potentially help banks in bad times.

Sixth, we find that while the US and Basel LCR run-off rates appear appropriate, the NSFR rates may be insufficient. 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 run-off 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 interest rates sufficiently above market, apparently even while under supervisory restrictions on deposit rates. We show that the bank we study was quite effective in using this method to offset deposit run-off 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
CD	0.433	0.424	0.395	0.773
Savings	0.509	0.433	0.415	0.107
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 Above Market	2.836	2.152	0.817	0.636
Average Interest Spread Above Market	2.752	2.137	0.888	0.658
Average Daily Withdrawal Amount	-90.82	-355.3	-936.80	-995.40
Average Daily Deposit Amount	418	1123	2481	1763
Average Daily Number of Withdrawals	0.013	.015	.052	0.053
Average Daily Number of Deposits	0.026	0.040	0.040	0.023
Share of Days with Withdrawals	0.008	.011	0.022	0.024
Share 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
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 four 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. “Types of Account at Bank” takes an integer value of 1 to 3 for each depositor, counting the number of deposit products they will have over their lifetime among CD, savings, and checking accounts.

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 Above Market	2.979	3.089	1.763	0.554
Average Interest Spread Above Market	3.034	3.058	1.250	0.693
Average Daily Withdrawal Amount	-166.30	-171.9	-215.0	-303.1
Average Daily Deposit Amount	157.90	159.20	213.90	252.60
Average Daily Number of Withdrawals	0.038	.035	.040	0.056
Average Daily Number of Deposits	0.018	0.017	0.016	0.020
Share of Days with Withdrawals	0.024	0.021	0.022	0.029
Share 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
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 four event periods. All statistics are calculated within the relevant event period and exclude all other days. “Types of Account at Bank” takes an integer value of 1 to 3 for each depositor, counting the number of deposit products they will have over their lifetime among CD, savings, and checking accounts.

Table 3: Who Withdraws? Placebo Period; Transaction Deposits

	Cox P.H. (1)	*LPM* (2)	*Probit* (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)
Direct Deposit	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
Log Likelihood	-91443.5	-19957.9	-19195.9
Model P-Value	<0.001	<0.001	<0.001
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 two months 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, derived from standard errors clustered at the depositor level. Estimates significant at 99% are denoted with ***, 95% with **, and 90% with *.

Table 4: Who Withdraws? Pre-Crisis Period; Transaction 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)	
Direct Deposit	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	
Log Likelihood	-132137.5	-23678.2	-22564.3	
Model P-Value	<0.001	<0.001	<0.001	
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 two months 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, derived from standard errors clustered at the depositor level. 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 Placebo period. Differences significant at the 5% level are represented by †† and 10% by †.

Table 5: Who Withdraws? Post-Crisis Period; Transaction 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)	
Direct Deposit	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	
Log Likelihood	-59487.4	-14669.5	-14693.5	
Model P-Value	<0.001	<0.001	<0.001	
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-cCrisis period Liquidation is defined as withdrawing 50% or more of the account balance and remaining below that level for two months 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, derived from standard errors clustered at the depositor level. 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 Placebo period. Differences significant at the 5% level are represented by †† and 10% by †.

Table 6: Who Withdraws? Formal Enforcement Action; Transaction 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)	
Direct Deposit	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	
Log Likelihood	-87251.0	-17801.7	-17003.4	
Model P-Value	<0.001	<0.001	<0.001	
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 two months 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, derived from standard errors clustered at the depositor level. 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 Placebo 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
Log Likelihood	-15709.6	-3992.8	-3803.3
Model P-Value	<0.001	<0.001	<0.001
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 two months 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, derived from standard errors clustered at the depositor level. 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	
Log Likelihood	-50106.0	-6697.7	-6372.4	
Model P-Value	<0.001	<0.001	<0.001	
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 two months 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, derived from standard errors clustered at the depositor level. 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 Placebo 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.	*LPM*	*Probit*	*Difference vs. Placebo*
	(1)	(2)	(3)	(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	
Log Likelihood	-18396.7	-3807.8	-3742.0	
Model P-Value	<0.001	<0.001	<0.001	
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 two months 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, derived from standard errors clustered at the depositor level. Estimates significant at 99% are denoted with ***, 95% with **, and 90% with *. 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 Placebo period. Differences significant at the 5% level are represented by †† and 10% by †.

Table 10: Uninsured Transaction Account Migration

Deposit Insurance Limit = $100,000

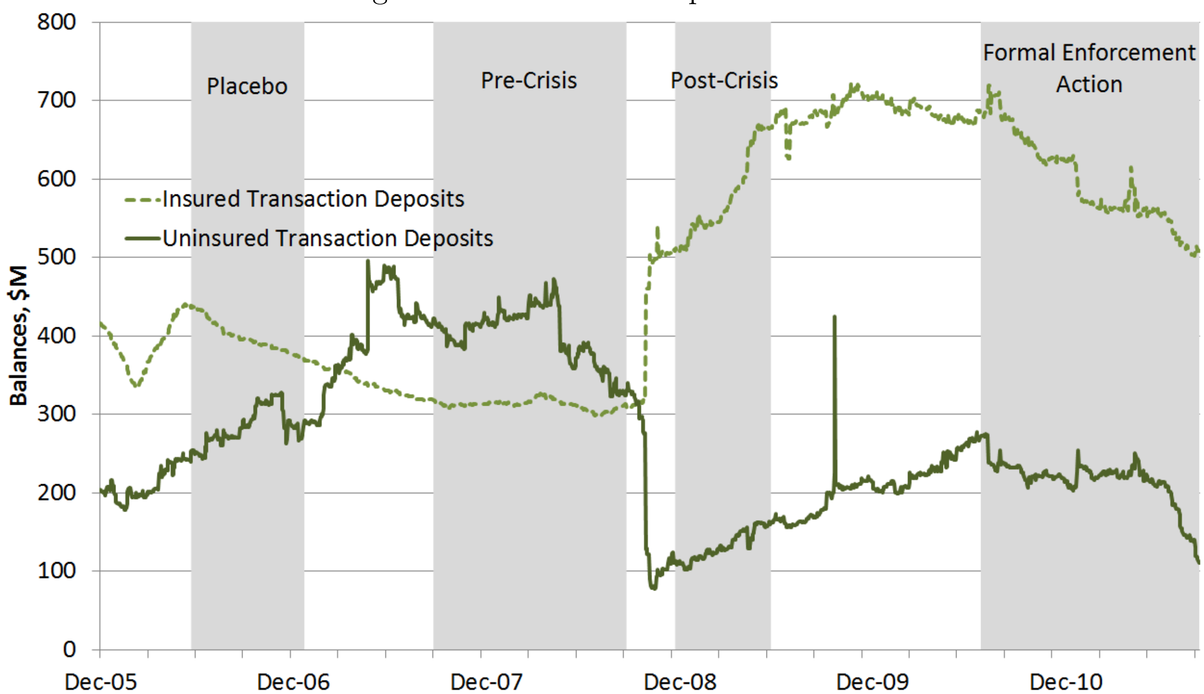
Bin Range	*<$1*	*$1 - 2,000*	*$2,000-48,000*	*$48,000-98,000*	*$98,000-102,000*	*>$102,000*
Placebo	6.0%	8.1%	11.2%	10.4%	11.7%	52.4%
Pre-Crisis	9.0%	8.2%	9.9%	15.5%	16.2%	41.3%

Deposit Insurance Limit = $250,000

Bin Range	*<$1*	*$1 - 2,000*	*$2,000-123,000*	*$123,000-248,000*	*$248,000-252,000*	*>$252,000*
Post-Crisis	2.1%	6.0%	14.5%	12.0%	1.7%	63.7%
Formal	23.2%	7.7%	23.6%	14.3%	6.5%	24.6%

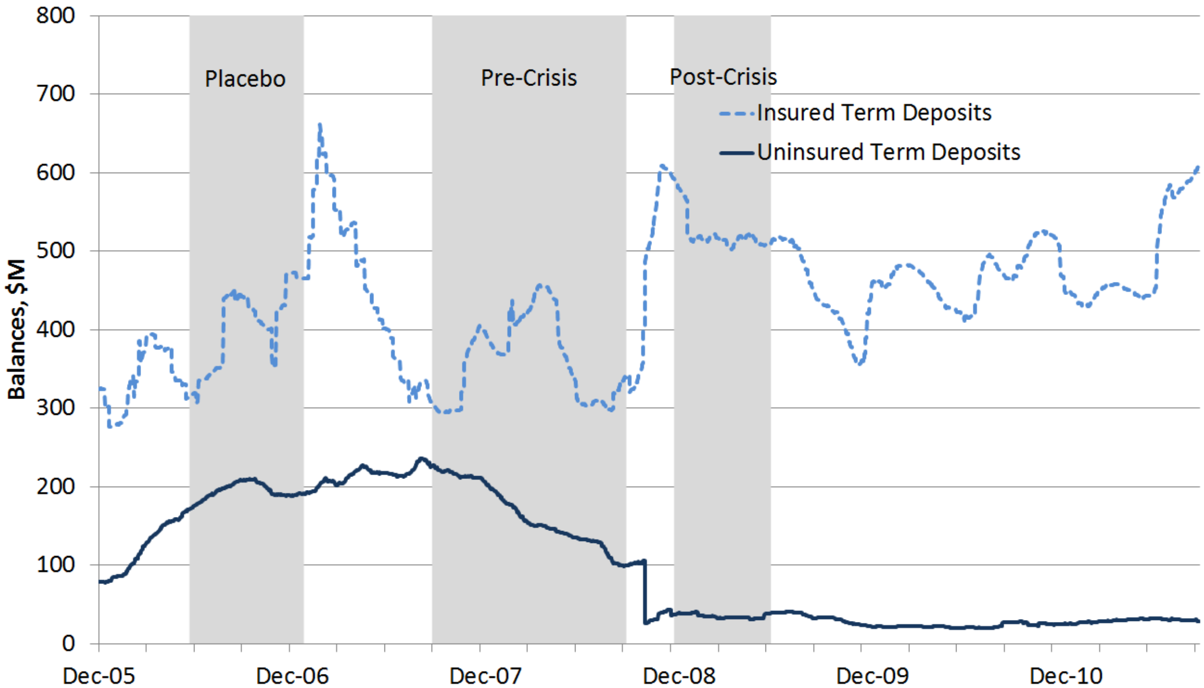
For all transaction accounts which were $2,000 shy of the deposit insurance limit or higher at the beginning of each period, this table shows their distribution into various account-size bins at the end of the period.

Figure 1: Transaction Deposit Balances



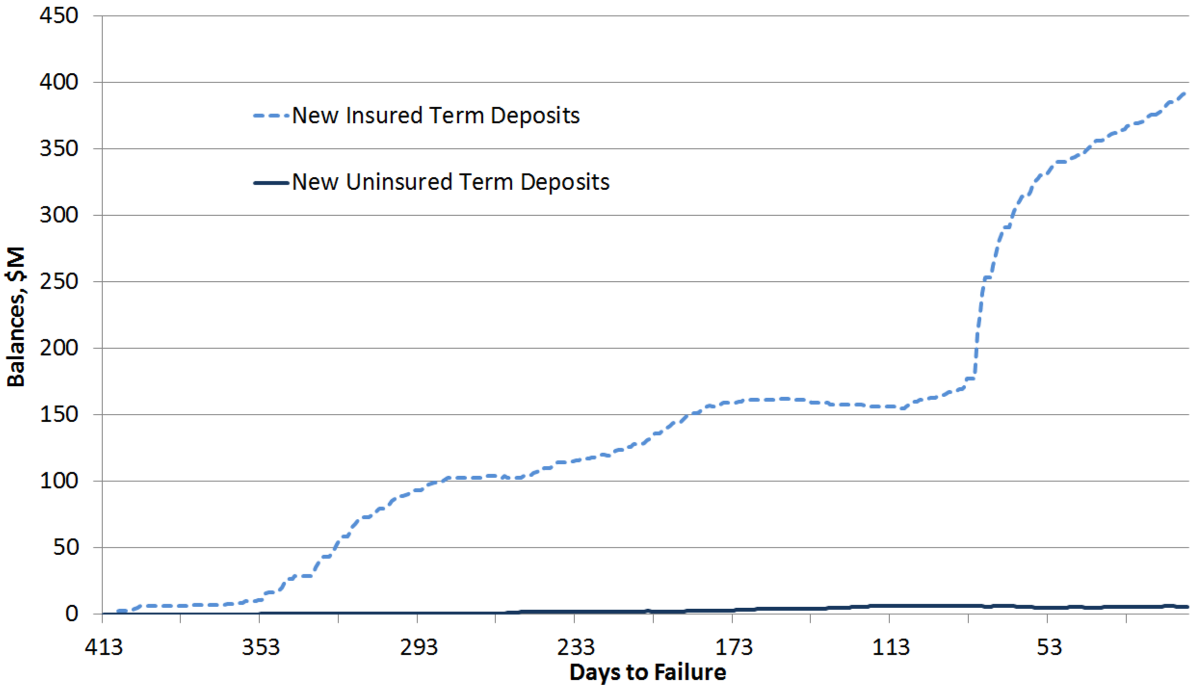
This figure shows total balances in transaction deposit accounts. The dotted light green line shows those deposits which were fully insured, while the solid dark green line shows total balances in less-than-fully-insured accounts. Grey bars denote the time periods analyzed in the regressions of Section 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 2: Term Deposit Balances



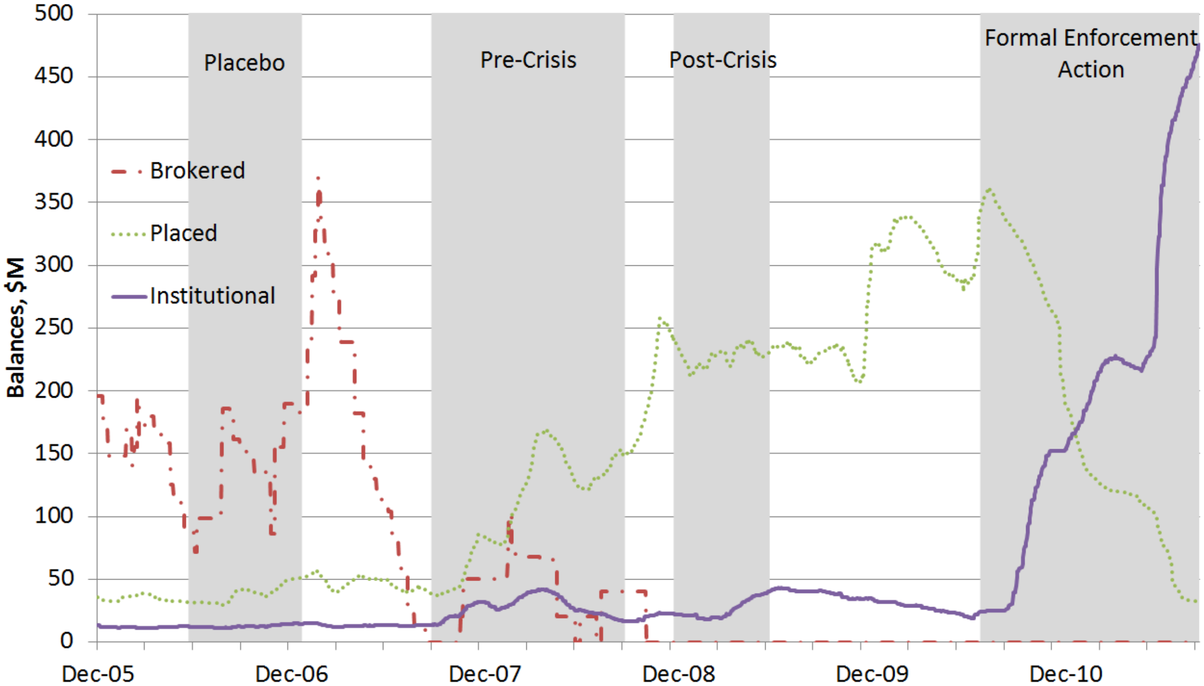
This figure shows total balances in term deposit accounts. The dotted light blue line shows those deposits which were fully insured, while the solid dark blue line shows total balances in less-than-fully-insured accounts. Grey bars denote the time periods analyzed in the regressions of Section 4, and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

Figure 3: Term Deposit Balances From New Depositors



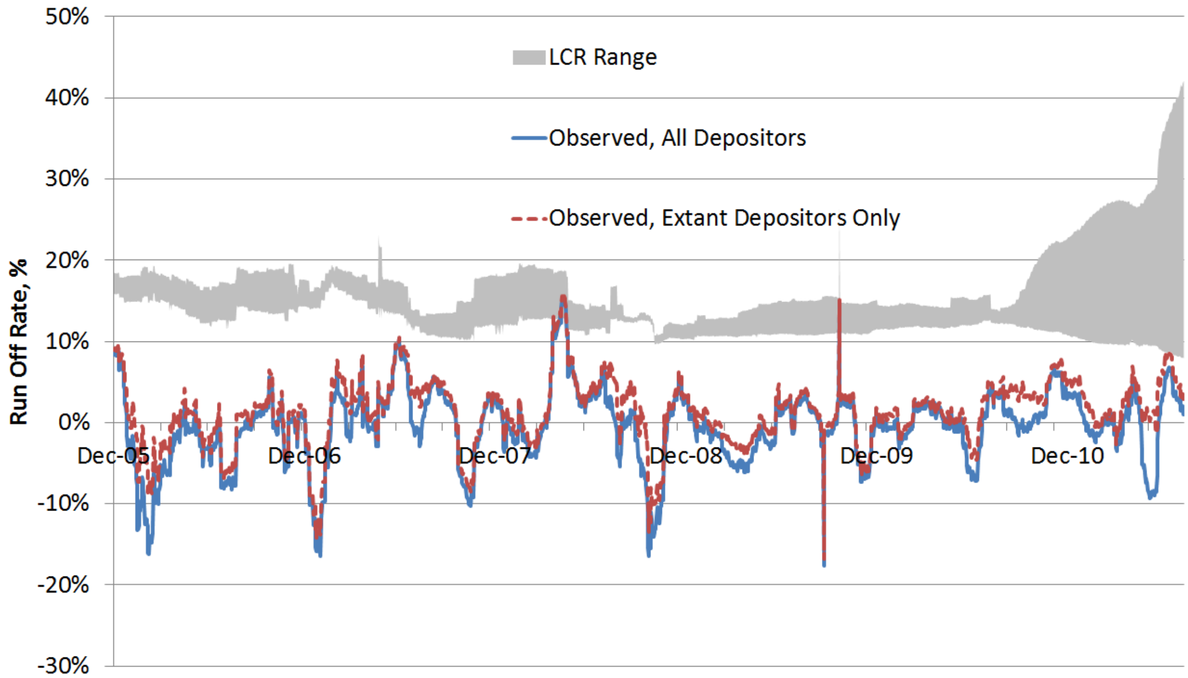
This figure shows balances in term deposit accounts from depositors who opened their first deposit account with the bank after the formal enforcement action — new depositors. The dotted light blue line shows those deposits which were fully insured, while the solid dark blue line shows total balances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

Figure 4: Term Deposit Balances in Brokered, Placed, and Institutional Accounts



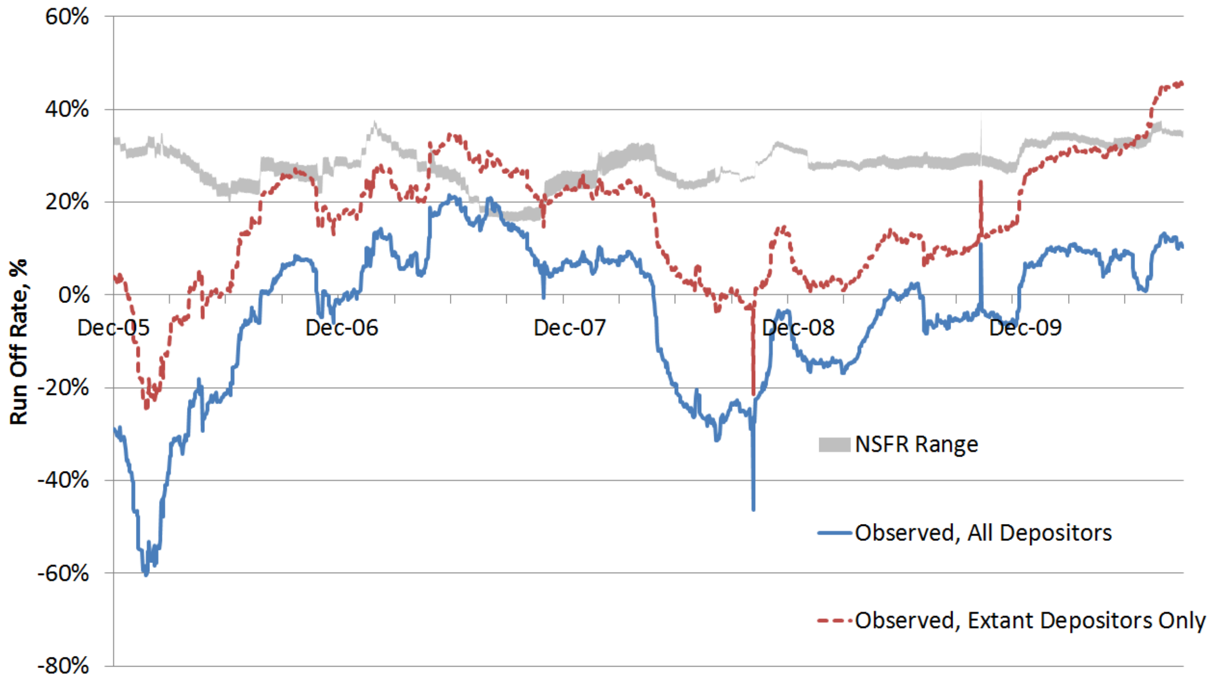
This figure shows term deposit account balances in brokered (dash-dotted red), placed (dotted green), and institutional (solid blue) accounts. Placed deposits are non-brokered deposits placed by a financial institution on behalf of a third party. Note that this is a different notion of placed deposits relative to that used in the regressions; here, we split placed and brokered deposits into two categories whereas both were grouped as "placed in the regressions. 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 5: 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 6: 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 one-year 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 year.