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Essays on Bank Deposit Flows and Deposit Rates as a Market Disciplining Mechanism

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ESSAYS ON BANK DEPOSIT FLOWS AND DEPOSIT RATES AS A MARKET DISCIPLINING MECHANISM

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Abstract

Deposits are the single largest source of funding for banks and are thus key to the stability of the banking system. Deposit flows and deposit rates are two mechanisms through which depositors discipline banks from excessive risk taking thus keeping the banking system stable.

In Chapter 1, I examine aggregate deposit inflows, outflows, and the reallocation of deposits in the banking system to further our understanding of banking stability. I find that on average deposit inflows are nearly three times larger and twice more volatile than outflows. Deposit flows vary with business cycles and market conditions, across deposit types, and cross-sectionally. Moreover, there is considerable heterogeneity in flows across deposit types. I also find that the largest banks attract and retain more deposits compared to smaller banks, and deposits are reallocated from small to largest banks. Deposits are also reallocated to banks which offer higher deposit rates, have lower insolvency risk assets, and low capital levels. My findings imply that deposit inflows and the heterogeneity in depositors are important in understanding banking stability. Moreover, at the aggregate level deposits are reallocated to banks that provide more utility to depositors, suggesting some evidence of market discipline.

In Chapter 2, I examine the role of bank accounting information in addressing information asymmetry problems between banks and depositors. I present evidence that rates on large, time deposits (CDs) increase with loan loss provisions (LLPs), especially non-discretionary provisions. These effects are pronounced from the financial crisis on-wards, where timelier provisioning reduces deposit rates. Furthermore, provisioning by banks that experience high loan growth and are profitable increases deposit rates, while banks that are conservative in accounting for their loan charge offs experience lower deposit rates. Additionally, in contrast to discretionary provisions, non-discretionary provisions that contribute to economic capital (in excess of Tier 2 regulatory capital) reduce deposit rates. These findings support the use of accounting information in providing market discipline, the third pillar in the regulatory framework proposed in the Basel III accord.

1 Gross Deposit Flows

1.1 Introduction

Instability in banking is typically associated with deposit outflows. Recent case-study evidence reveals a richer set of details associated with these outflows. The rate of outflows differs across deposit types. Deposit insurance and duration of depositor relationships slow the rate of deposit outflows (Iyer and Puri (2012), and Iyer, Puri, and Ryan (2016)). Furthermore, deposit inflows occur alongside deposit outflows (Martin et al. (2018)). Moreover, recent theoretical work also suggests the reallocation of deposit outflows from distressed banks to healthy banks (Egan, Hortaçsu, et al. (2017)). Understanding stability in banking therefore requires moving beyond examining net flows (deposit outflows) at distressed banks or during crises periods. It requires an understanding of gross deposit flows - the rates of inflows and outflows, their persistence and volatility, cross-sectional variation across deposit types, time-series variation across the business cycle and market conditions, and how inflows and outflows combine to reallocate deposits in the banking system.

Moreover, we need to understand whether the magnitude of these gross deposit flows is large enough to cause instability to the banking system as a whole, and how do these deposit flows measure against proposed regulatory changes to liquidity and stable funding. This paper examines gross deposit flows to answer some of these questions and to establish facts that can further our understanding of banking stability.

I begin by examining aggregate deposit inflows and outflows to understand the magnitude, volatility, and persistence of deposit flows. Using quarterly bank level data from 1984-2017, I find the following: The average rate of deposit inflows (3.7%) is more than three times the the average rate of deposit outflows (1.1%). Deposit inflows are also more than twice as volatile as deposit outflows.[1] Moreover, I find that entries (de-novo

[1] I place a caveat here that my measure of the rates and volatility of deposit flows are downward biased since my fundamental unit of analysis is the bank and thus I compute only inter-bank deposit flows and do not include intra-bank deposit flows.

banks) and exits (failures or mergers) do not have a significant effect on aggregate deposit inflows or outflows in the banking system, respectively. Deposit inflows and outflows are however persistent across banks and time periods. On average only 50% of the deposits that come into a bank during a quarter, stay with the bank for an additional quarter. I also find that during any given time period, including recessions, there are simultaneous inflows and outflows of deposits. Even in periods of net deposit outflows there are deposit inflows. While Martin et al. (2018) find evidence on simultaneous inflows and outflows of deposits at a failing bank, I find that simultaneous inflows and outflows of deposits exist at the aggregate industry level. These findings suggest the importance of considering deposit inflows in addition to outflows when examining the effect of deposit flows and bank stability.

Deposit inflows and outflows also vary across deposit types. The rates of inflows (3.9%) and outflows (1%) of core deposits (insured) are lower than the corresponding rates (7.3% for inflows and 5.2% for outflows) for large time-deposits (uninsured).[2] These aggregate level deposit outflows (run-off) rates are much lower than those considered in the Basel III regulations on liquidity and stable funding (Basel III, 2013). Basel III regulations assume a run-off rate of 5% (minimum of 3%) for stable funding sources, which in my case are core deposits, and a run-off rate of 10% or higher for less stable funding sources, or in my case large time-deposits. These findings suggest that the deposit run-off rates considered in the Basel regulations may be more conservative than the run-of rates observed. Core deposit inflows and outflows are also less volatile than large time-deposits. However, in dollar terms, core deposit inflows are nearly three times the inflows of large time-deposits, while outflows are of comparable magnitude. These findings indicate that despite explicit withdrawal restrictions on large time-deposits, they are more withdrawal-prone compared to core deposits, even though the rates of outflows may not be as high as considered in the Basel regulations.

[2]Core Deposits include total transaction deposits, savings deposits, and small time-deposits. Large time-deposits are defined as time deposits $\geq$ \$100,000 prior to Q1,2010 and time deposits $\geq$ \$250,000 since.

Across deposit types, Martin et al. (2018) find evidence that outflows of uninsured deposits at a failing bank positively affects the outflows of insured deposits. They also find that the failing bank manages to replace some of the outflows in uninsured deposits with insured deposits. However, at the banking system level I do not find any evidence of contemporaneous relation between outflows of core and large time-deposits, though they are non-contemporaneously related. I also find that there is a contemporaneous and lagged substitution effect between core deposits and large time-deposits. While core deposit outflows are correlated with large time-deposit inflows, large time-deposit outflows are only non-contemporaneously correlated core deposit inflows. By looking at the aggregate level of deposit flows I find that such a substitution effect is not unique to failing banks. Moreover, the substitution effect of core deposit outflows and large time-deposit inflows is primarily evident in banks with low capital, high levels of NPA (Non-performing assets), and banks with low levels of loan charge-offs. So while there might be a substitution effect between core and large time-deposits at times, the directionality and magnitude of substitution various with bank distress levels. These findings have important implications in designing regulations on the sources of funding distressed banks can access, which may affect the costs borne by the regulatory agency in case of failure of the depository institution.

Deposit inflows and outflows also vary with market and economic conditions, and across deposit types. I find that the aggregate rate of deposit inflows increases during periods of high stock market returns, and the rate of deposit outflows decreases during periods of high economic activity. Across deposit types, I find that the rate of inflows of core deposits increases during periods of high stock returns, suggesting a wealth effect. On the other hand, the rate of inflows of large time-deposits increases during periods of high market volatility, suggesting that depositors view banks as “safe havens” during periods of market uncertainty. High economic activity also affects core deposits and large time-deposits differently. For core deposits, while both the rate of deposit inflows and outflows decrease, for large time-deposits only the rate of outflows decreases. Large time-deposits are also more sensitive to changes in the benchmark rate of return (the federal funds rate), compared to core deposits. While Egan, Hortaçsu, et al. (2017) find that the demand for both insured and uninsured deposits are price inelastic, [3] I find that increases in the federal funds rate leads to higher inflows and lower outflows for large time-deposits. However, there is no such effect observed for core deposits. These findings further elaborate on the sensitivity of different deposit types to changes in macro economic and market conditions, and benchmark rates of return.

Thus far my focus has been on the inflows and outflows of deposits in the banking system. However, in addition to inflows and outflows there is also a reallocation of deposits amongst banks. Egan, Hortaçsu, et al. (2017) give an example where the market share of uninsured deposits drops for a distressed bank while simultaneously the market share of uninsured deposits for a healthy bank increases. They suggests there might be a movement of deposits from one bank to another. I next examine the cross-sectional variation in deposit flows, and in addition to deposit inflows and outflows, I also look at the reallocation of deposits within banks of similar size groups. The ratio of deposit inflows to outflows decreases monotonically from the largest to the smallest bank. For every \$1 of outflows, the largest banks attract \$9, while the smallest banks only attract roughly \$2.6. On the other hand the the ratio of deposit reallocation to outflows increases monotonically from the largest to the smallest bank. For every \$1 of outflow for the largest banks, \$1.89 are reallocated amongst the largest banks, while for the smallest banks \$1.96 are reallocated. The trends are consistent for both core deposits and large time-deposits. These findings suggest that the largest banks both attract and retain more deposits compared to the smaller banks, for every dollar of deposit outflow. Since the largest banks also have the most number of branches, these higher ratios of deposit inflows to outflows at the largest banks suggests the importance of branch networks, not only in in their ability to attract deposits, but also in reducing information asymmetry and monitoring costs (Aguirregabiria et al., 2017), and thus retaining more deposits. This monotonic trend in the ratios of deposit inflows-to-outflows and reallocation-to-outflows

[3] They calibrate a model of deposit demand using parameters for interest rates offered and probability of default to arrive at price elasticity.

to cannot be captured with deposit growth rates, or deposit market share alone, and is thus valuable in understanding the funding risks faced by community banks vis-a-vis larger banks.

In addition to the reallocation of deposits within bank size groups, deposits are also reallocated across groups. I find that nearly 60% of the reallocation of core deposits is inter-group, while for large time-deposits it is only 30% , the rest being intra-group. I find that while the rates of reallocation of large time-deposits is larger than that for core deposits, large time-deposits are reallocated across banks of similar size. This suggests that the reallocation of large time-deposits is largely due to heterogeneity in bank-level dynamics within similar size groups. These figures however do not give us the direction of deposit flows. I develop on the methodology used by Meller and Metiu (2017) to measure synchronization of economic cycles across countries, to ascertain the direction of deposit flows. I find that deposits flow from smaller banks to larger banks, and this is largely evident for core deposits, post Riegle-Neal (RN) and post Gramm-Leach-Bliley (GLB), while there is no such effect for large time-deposits. One possible explanation for this effect could be the "economies of scale" enabled by RN which allowed banks to acquire other banks and operate across state boundaries and become larger, and the "economies of scope" enabled by GLB that allowed banks to engage in investment banking and insurance business in additional to commercial banking activities. Both the scale and scope effects allowed the banks to establish relationships with depositors, and hence the effect is evident more for core deposits which are more relationship based compared to large time-deposits. Combining the findings on the rates of inflows and outflows across bank size groups with the magnitude and direction of deposit outflows at smaller banks, these findings suggest that smaller banks have been losing deposits to the largest banks, and may be more vulnerable to deposit outflows and funding shortages compared to their larger counterparts.

To further understand the reallocation of deposits within the banking system, I look at deposit flows across bank characteristics. I use the basic framework of Egan, Hortaçsu, et al. (2017) to interpret my results. They suggest a model where insured and uninsured depositors choose between differentiated banks based on individual utility maximizing preferences. This utility is derived from deposit rates offered, the probability of default, and the banks' ability in using these deposits effectively. And, depositors are run-prone and can move their deposits from one bank to another.

I first look at utility derived from deposit rates offered. Deposit rates offered can be viewed in two ways. One the one hand DeAngelo and Stulz (2015) suggest that banks that enjoy deposit rate advantages (lower deposit rates than competitors in the same market) should have lower leverage, or in my case lower levels of deposits.[4] Deposit rate advantages could arise for instance from lower servicing costs on loans and deposits. It could also result from distress of other banks, which raise rates during distress to attract deposits (Acharya and Mora, 2015). I consider banks having a deposit rate advantage as the percentage of branch-products in which the bank offers deposit rates lower than the median rate for that product in an MSA. Higher the percentage, greater the banks' deposit rate advantage. I find that rates of deposit inflows (outflows) are lower (higher) at banks that have a deposit rate advantage, corroborating DeAngelo and Stulz (2015). The findings are qualitatively similar for core deposits and large time-deposits. However, deposits are reallocated from banks that offer lower deposit rates to those with higher deposit rates. This finding is more in line with Egan, Hortaçsu, et al. (2017) who suggest that distressed banks have lower demand for uninsured funds and hence suggestively lower rates, and with Ben-David et al. (2017) who suggest that deposit rates are associated with demand for funds and thus banks raise rates to attract funds.

I next look at the (dis)utility to depositors resulting from banks' probability of default. In their calibrated model Egan, Hortaçsu, et al. (2017) find that a 1% increase in the risk-neutral probability of default leads to a 12% decrease in the market share of uninsured deposits for a bank, while there is no such effect on insured deposits. They attribute this to both a lowered demand for uninsured deposits and a drop in the supply. I measure

[4] They use the term "liquidity premium", but the essence is the same.

a banks' insolvency risk as the ratio of non-performing assets (NPA's) to total loans, and the ratio of Charge-Offs to NPA's. The first measure gives an estimate of a banks' probability of default (PD), while the second measure is an estimate of the banks' loss-given-default (LGD). I find that the rate of deposit inflows is roughly 43% lower, and the rate of deposit outflows is nearly 77% higher at banks with a high insolvency risk. However, the disparity in deposit inflows is more prominent in large time-deposits, while the disparity in outflows is more visible in core deposits. This is contrary to expectations that uninsured depositors would be the first to leave a distressed bank. Deposits are reallocated from banks with a high probability of default to those with a low probability of default, suggesting some market discipline. However, it is important to note that even at banks with a higher probability of default there are simultaneous inflows and outflows of deposits.

Lastly I look at the role of equity capital in deposit flows. Equity capital has been studied as both in mitigating a banks' risk of failure (Bhattacharya and Thakor (1993); Repullo (2004); and Von Thadden (2004)), or diminish a banks' ability to create liquidity by affecting the banks' incentives to monitor its borrowers (Diamond and Rajan (2000); and Diamond and Rajan (2001)). I focus on the latter since in my setup depositors derive utility from the banks' management in actively monitoring its borrowers and generating returns sufficient enough to repay the depositors. I find that the rates of deposit inflows are 34% higher at banks with high capital levels, while rates of deposit outflows are nearly 76% higher. Deposits however are reallocated from banks with high capital to banks with low capital, suggesting a reallocation towards banks that are better at producing liquidity. Again, it is worthwhile to note that even at banks with low capital levels, there are simultaneous inflows and outflows of deposits.

My findings suggest that merely focusing on deposit outflows at distressed banks may not reveal a complete picture of how deposit flows affect bank stability. I extend case-studies on individual banks to the aggregate level and show that there are simultaneous inflows and outflows of deposits across bank and deposit types, and rates of inflows and outflows vary across deposit types, and deposits flows across banks. My study provides evidence on the stability of various account types based on economic and market conditions, bank size, and the utility that depositors generate. My study has important implications for future research in the design of regulations related to banking system liquidity and stable funding.

1.2 Background and Related Literature

Deposit flows and banking stability have traditionally been studied under theoretical models of bank runs. Seminal work of Diamond and Dybvig (1983) suggests the mechanism through which deposit flows affect the (in)stability of banks. Works such as Postlewaite and Vives (1987), Peck and Shell (2003), Goldstein and Pauzner (2005), and Gertler and Kiyotaki (2015) have further examined bank-runs as an equilibrium response by depositors to bank health. On the other hand, Chari and Jagannathan (1988), Jacklin and Bhattacharya (1988), and Uhlig (2010) model bank-runs as purely information based response by depositors.

Empirically, Gorton (1988), Saunders and Wilson (1996), and Calomiris and Mason (1997) find that bank-runs are related to the banks' fundamentals, while Calomiris and Mason (1997) find that in addition to bank fundamentals, panic amongst depositors also plays a role. In addition to bank-runs, deposit withdrawals have also been studied as a market disciplining mechanism. Martinez Peria and Schmukler (2001) examine the banking crises in Latin America and find that depositors withdraw their deposits as means of disciplining the banks. Park and Peristiani (1998) find that in addition to deposit withdrawals, depositors also demand higher rates on deposits from distressed banks, as a disciplining mechanism.

These studies have largely considered depositors as a homogeneous group and focused on deposit outflows at failing/distressed banks. More recent case studies have found evidence that depositors are in-fact heterogeneous in nature, and respond differently to a banks' solvency risk. While some depositors leave the bank immediately at the slightest hint of insolvency, others are more patient. Depositor-bank relationships and deposit insurance plays an important role in depositors' response to perceived insolvency risk. Recent empirical evidence has also shown that even at failing banks there are simultaneous inflows and outflows of deposits, contrary to what one might expect. Moreover, recent theoretical models suggest that depositors can distinguish between healthy and distressed banks, and provide empirical evidence that deposits are reallocated from distressed to healthy banks.

To examine the heterogeneity in depositor behavior in response to perceived solvency risk, Iyer, Puri, and Ryan (2016) use deposit account-level data and examine two bank-runs on an Indian bank at different time periods. This bank was subject to a low level and a high level solvency shock over two different time periods, years apart. They find that depositors with loan relationships with the bank were less likely to run during the low solvency shock, while uninsured depositors are more likely to run. In the high solvency shock event, they find that depositors with longer relationships with the bank were less likely to run, while those with frequent past transactions were more likely to run. These findings suggest that considering depositors as a homogeneous group may not represent a complete picture in understanding the effect of deposit flows on bank stability.

In another study Martin et al. (2018) use deposit account-level data at a failing Indian bank and find that even at that failing bank there are simultaneous inflows and outflows of deposits. They find that temporary deposit guarantee measures introduced at the time of the financial crisis, and deposit insurance slows down the rate of deposit outflows. Uninsured deposits are replaced by insured deposits even when the banks' failure is public knowledge. Moreover, the inflow of deposits is large in magnitude and has a first-order impact. So, while prior literature has largely focused on deposit outflows in assessing a banks' stability, this new evidence suggests that we need to look at both inflows and outflows in understanding bank stability.

To further emphasize the heterogeneity in depositor behavior to bank insolvency risk, Egan, Hortaçsu, et al. (2017) suggest a model where insured and uninsured depositors choose between differentiated banks based on their individual utility. They suggest that insured depositors are less sensitive to a banks' probability of default as they derive utility from banking services. Uninsured depositors on the other hand derive utility only from the deposit rates offered and since they would lose their deposits in case of a bank failure, are more sensitive to a banks' probability of default. They also cite an example where the market share of uninsured deposits for a distressed bank fell, while at the same time the market share of uninsured deposits increased for a healthy bank. Results from their calibrated model suggests that depositors can perceive solvency risk and move their deposits from distressed to healthy banks.

In addition to individual bank health or the health of the banking system, the aggregate demand for and supply of deposits is also affected by business cycles and market conditions (Martin et al., 2018). High levels of economic activity and market returns would lead to higher inflow of deposits into the banking system, suggesting wealth effects (Bomberger, 1993). High market volatility on the other hand would also lead to an increase in deposit inflows, since due to deposit insurance banks are viewed as "safe havens" (Acharya and Naqvi, 2012). Allen et al. (2015) suggest a model where deposits flows into banks depends on the other alternative storage technologies available to investors. They suggest if investors can generate higher returns from these other technologies there would be lower deposits available for banks and vice-versa.

Empirically, however Acharya and Mora (2015) and Helwege et al. (2017) find that banks faced funding shortfalls during the financial crisis and were only able to create liquidity due to support from the government and government-sponsored agencies. Pérignon et al. (2018) on the other hand find there were no wholesale funding dry-ups during the financial crisis. Additionally, Gatev and Strahan (2006) find that bank deposit flows increased in periods of market-wide liquidity shocks prior to the crisis.

In addition to bank insolvency risk, economic and equity market conditions, theories of bank capital suggest differences in leverage across banks based on individual bank attributes. Since leverage is the net result of changes in inflows and outflows, deposit flows should vary with individual bank attributes. DeAngelo and Stulz (2015) suggest that as a product of financial intermediation, banks produce a safe liquid claim, namely deposits, banks should be able to charge a liquidity premium for this service. This is similar in spirit to Krishnamurthy and Vissing-Jorgensen (2012) and Krishnamurthy and Vissing-Jorgensen (2013) who find a liquidity premium present in the prices of US Treasury securities. For banks however, this liquidity premium is generated in the form of deposit rate advantages. That is when a particular bank pays a lower rate of interest on its deposits compared to other banks offering similar products in the same market. DeAngelo and Stulz (2015) further suggest that higher the liquidity premium (or deposit rate advantage) higher the franchise value of the bank, and consequently lower the leverage.

In addition to the rate of return earned on their deposits, deposit flows are also affected by the demand for deposits at individual banks. Egan, Hortaçsu, et al. (2017) suggest that the demand for uninsured deposits drops for a bank in financial distress, while there is no prominent effect for insured deposits. This can be expected as insured depositors derive utility from banking services, while uninsured depositors who could lose all their funds in case of a bank failure, would be more sensitive to a banks' insolvency risk. However, both insured and uninsured depositors are sensitive to a banks' probability of default albeit to varying degrees as both lose some utility with bank failure. Egan, Hortaçsu, et al. (2017) further suggest that depositors are fully rational, can anticipate a banks' probability of default and more their deposits from distressed to healthier banks. So a banks' probability of default would be expected to affect the deposit inflows and outflows at that bank.

The returns a bank is able to generate for its depositors is dependent on the loan premium the bank is able to generate through its lending activities. This loan premium is a function of the banks' information production on their borrowers (Diamond, 1984) and (Campbel and Kracaw, 1980), by screening borrowers at loan origination (Stiglitz and Weiss, 1981), and monitoring the borrower over the life of the loan (Berger and Udell, 2002). Equity capital plays a critical role in this intermediation process. On the one hand equity capital can aid in generating a loan premium via the "risk absorption" hypothesis. It can mitigate the risk of bank failure (Bhattacharya and Thakor (1993); Repullo (2004); and Von Thadden (2004)). Equity can also diminish a banks' ability to generate a loan premium by affecting the banks' incentives to monitor its borrowers (Diamond and Rajan (2000); and Diamond and Rajan (2001)), or the "financial fragility crowding-out" hypothesis. Through the "risk absorption" and "financial fragility crowding out" hypothesis, equity capital can affect deposit inflows and outflows.

The "risk absorption" hypothesis considers equity capital to be a cushion against unexpected losses, and correspondingly the greater the cushion, lower the insolvency risk. Berger and Bouwman (2013) find that higher levels of equity capital help reduce a banks' insolvency risk especially during crises when the risk of insolvency is higher. They also find that higher capital levels aids a bank in increasing its market share thereby contributing to liquidity creation. Allen et al. (2015) and Mehran and Thakor (2011) provide theoretical foundations on how higher levels of equity capital help a bank expand its market share. Empirically, Calomiris and Mason (2003) find that banks with higher levels of equity capital are better able to compete for deposits and loans, that is produce liquidity. Conversely, Koehn and Santomero (1980) find that increases in regulatory capital actually increases the banks' portfolio risk and consequently increasing its insolvency risk.

On the other hand, the "financial fragility crowding-out" hypothesis considers equity to be an impediment to liquidity creation. (Diamond and Rajan, 2000) argue that higher equity capital makes the banks less fragile, thereby reducing the banks' incentives to monitor its borrower and affects its lending activity, and consequently affecting its ability to produce liquidity. Aiyar et al. (2012) study the UK market and find that regulated banks decrease lending in response to tighter capital requirements, while the effect is opposite for unregulated banks. Conversely, Jiménez et al. (2017) study the Spanish market and find that increases in capital buffers increases liquidity production by banks, and subsequently employment by firms and the banks' survival probability.

1.3 Data and Methodology

Data on deposits is obtained from the Reports of Condition and Income ("Call Reports") filed by banks with their respective supervisory agencies every quarter. Call Reports can be obtained from the Chicago Federal Reserve website in machine readable form.[5] I focus on Total Deposits, Core Deposits, and Large Time-Deposits. For Core Deposits I use the Uniform Bank Performance Report (UBPR) definition (Council, 2006) where Core Deposits include total transaction deposits, savings deposits, and small time deposits. Large time-deposits are defined as time deposits $\geq$ \$100,000 prior to Q1,2010 and time deposits $\geq$ \$250,000 since. My sample period for data on deposits runs from Q1,1984 - Q4,2017.

Data on deposit products, deposit rates, bank branches, and the MSA of those branches is obtained from RateWatch. RateWatch provides weekly branch level deposit rates for all US commercial banks for a wide range of deposit account types. Data from RateWatch is available from January 1997 onwards. Weekly deposit rates across branches are aggregated to the branch level each quarter to arrive at average deposit rates for each bank-branch, quarter, and deposit product type.

Data on economic indicators, such as the Gross Domestic Product (GDP), Federal Funds Rate, Coincident Economic Activity Index (CEA), and the Leading Index was obtained from the Federal Reserve Economic Date (FRED) made available by the St. Louis Federal Reserve. The Coincident Economic Activity Index measures the employment and payroll activities, while the leading index predicts the aggregate 6-month growth rate for the CEA Index.

Aggregate Measures

To compute deposit flow rates, measures of persistence, and index of inter-group flows I use the methodology developed by (Davis and Haltiwanger (1992), and Davis, Haltiwanger, Schuh, et al. (1998)), and used to compute credit reallocation rates in (Herrera et

[5] https://www.chicagofed.org/banking/financial-institution-reports/commercial-bank-data

al., 2011), and gross credit flow rates in (Dell'Ariccia and Garibaldi, 2005). Computation of aggregate deposit flow rates and other measures of deposit reallocation is described in the following sections.

Aggregate Flow Rates

The average deposits at a bank i between time $t-1$ and t is defined as d_{it}. For a set of n banks in the market, D_{it} is defined as the average of the total deposits of all banks. Deposit growth rate g_{it} for bank i at time t is defined as the ratio of the first difference between two time periods, divided by d_{it}. That is,

$$d_{it} = (Deposits_{i,t-1} + Deposits_{i,t})/2, \ and \ D_t = (\sum_{i=1}^{n} Deposits_{i,t-1} + \sum_{i=1}^{n} Deposits_{i,t})/2$$

$$g_{it} = (Deposits_{i,t} - Deposits_{i,t-1})/d_{it}$$

By construction, the growth measure g_{it} is bounded between $[-2, 2]$. For de-novo banks (entries) $g_{it} = 2$, while for failed/merged banks (exits)$g_{it} = -2$, for the quarter of entry or exit. In addition to being a bounded measure of growth, it incorporates a continuum of entries and exits in the banking system. This is especially important for the banking industry which has undergone substantial consolidation during the given time period. Aggregate deposit inflow rates (POS_t) are computed as the weighted average of the growth rates of banks with positive growth rates, while aggregate deposit outflow rates (NEG_t) are computed as the weighted average of the absolute values of growth rates for banks with negative growth in deposits. Specifically,

$$POS_t = \sum_{\substack{i=1 \\ g_{it}>0}}^{n} g_{it}(\frac{d_{it}}{D_t})$$

$$NEG_t = \sum_{\substack{i=1 \\ g_{it}<0}}^{n} |g_{it}|(\frac{d_{it}}{D_t})$$

Aggregate deposit reallocation rate is the sum of deposit inflow rate and deposit outflow rate ($SUM_t = POS_t{+}NEG_t$), and net inflow rate is the difference between deposit inflow rate and deposit outflow rate ($NET_t = POS_t - NEG_t$). Excess deposit reallocation is the difference between aggregate reallocation rate and the absolute values of net inflow rate ($EXC_t = AGG_t - |NET_t|$). EXC_t is the deposit reallocation amongst banks in excess of the minimum required to accommodate changes in deposits.

Persistence

The substantial rates (and dollar amounts) of deposit inflows and outflows each quarter raises the question whether these patterns are transitory, or are an integral part of the banking industry and intrinsic to the reallocation of deposits. To quantify the degree to which these changes are transitory or permanent I compute measures of persistence in deposit flows based on (Davis and Haltiwanger, 1992). The persistence measure for bank i at time t is computed as:

$$P_{it} = min\left[1, max\left(\frac{deposit\ growth\ rate_{t-2,t}}{deposit\ growth\ rate_{t-1,t}}, 0\right)\right]$$

A persistence measure of $P_{it} = 1$ indicates that all the new deposits that came into the bank at time t will stay with the bank for one more quarter, while a persistence measure of $P_{it} = 0$ indicates that these deposit inflows are temporary and will not last one additional quarter. The overall quarterly persistence measure for the industry is computed as the mean of quarterly persistence measures for all individual banks, or

$$P_t = \frac{1}{n}\sum_{i=1}^{n} P_{it}$$

.

Inter-Group Reallocation of Deposits

Previously we have seen that there is an excess reallocation of deposits across banks. To explore whether this inter-bank reallocation of deposits is within banks in similar size groups or across banks of different sizes, I compute an index of inter-group reallocation using the methodology of (Davis and Haltiwanger, 1992). The index is computed as:

$$W_t = 1 - \frac{\sum_{j=1}^{J}(|NET_{jt}|)}{\sum_{j=1}^{J}(SUM_{jt}|)}$$

where j=1,...,J denotes the groups. If all groups have only inflows or outflows of deposits then $SUM_{jt} = |NET_{jt}|$ and the index will have a value of 0. An index value of $W_t = 0$ suggests that all deposit flows are inter-group. Conversely, if all deposit flows are only intra-group that would imply $|NET_{jt}| = 0$ and the index value would be 1. An index value of $W_t = 1$ indicates that all the deposit flows are intra-group. $0 \leq W_t \leq 1$ measures the degree of deposit flows across groups. For example $0 \leq W_t < 0.5$ would indicate that a large fraction of the deposit flows are inter-group, while $0.5 \leq W_t < 1$ would indicate that deposit flows are predominantly intra-group.

Direction of Reallocation of Deposits

The measures for inter-group reallocation of deposits gives an idea about the degree of reallocation, but does not tell us anything about the direction of reallocation. To ascertain the direction of deposit flows I construct a directionality measure that builds on the methodology developed by (Meller and Metiu, 2017) to measure synchronization of economic cycles across countries. My directionality measure is constructed using a two-step procedure. In the first step, dummy variables are created for each individual banks' deposit growth rate g_{it}, where

$$Growth\ Dummy_{it}\ (G_{it}) = \begin{cases} 1 & \text{if } g_{it} > 0 \\ 0 & \text{if } g_{it} \leq 0 \end{cases}$$

Each quarter banks are classified "Large" or "Small" based on total assets. Banks in the top 1% in total assets are classified as large, the remaining are classified as small.

In the second step, I create a N*M matrix where N is the number of large banks and M the number of small banks. Each element in the matrix is assigned a value of

$+1, 0, or -1$ as follows, where the subscripts L stands large banks, and S for small banks.

$$Matrix_{ij,t} = \begin{cases} +1 & \text{if } G_{it,L} = 1 \text{ \& } G_{jt,S} = 0 \\ 0 & \text{if } G_{it,L} = 1 \text{ \& } G_{jt,S} = 1, \text{ or } G_{it,L} = 0 \text{ \& } G_{jt,S} = 0 \\ -1 & \text{if } G_{it,L} = 0 \text{ \& } G_{jt,S} = 1 \end{cases}$$

That is, each quarter deposit growth rate dummy or all large banks are compared to the deposit growth rate dummy of all small banks. If deposit growth rate at a large bank is positive while that at a small bank is negative the corresponding element matrix element is given a value of +1, if it is the other way round, it is given a value of −1. If growth rates at both the large and small banks are both positive or both negative, then a value of 0 is ascribed. Using this methodology, I can safely assume that each element of the matrix has a discrete uniform distribution, or $Matrix_{ij,t} \sim U[-1, 1]$.

The directionality measure for time t is computed as the average value of all elements of the $Matrix_{ij,t}$, or $\mu_t = \frac{\sum_{i=1}^{N} \sum_{j=1}^{M} Matrix_{ij,t}}{(M*N)}$. If the direction of deposit flows is truly random, then the value of the my measure is zero ($E[\mu_t] = 0$). This measure takes a value of 1 if all small banks had a negative deposit growth rate and all large banks had a positive deposit growth rate, suggesting that deposits were reallocated from the small banks to large banks. A value of −1 would mean deposits were reallocated from large banks to small banks, and a value of 0 would imply that the direction of reallocation is inconclusive.

When examining the direction of deposit flows between the largest and the smaller banks, I split my analysis on time periods prior to and after Reigle-Neal and GLB since the Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994 (Riegle-Neal) allowed banks to operate across state boundaries and hence promoted "economies of scale" in the banking industry, while the Gramm–Leach–Bliley Act (GLBA) allowed banks and financial institutions to offer investment banking and insurance services, thereby promoting "economies of scope". It is possible that the enhanced scale and scope economies available to large banks contributed to the reallocation of deposits from small to large banks.

Deposit Rate Advantages

I compute a banks' ability to enjoy deposit rate advantage as the number of branch-products in which the bank has a deposit rate lower than the median rate in the MSA where the branch is located. Let a bank i have $n = 1, ..., N$ branches and offers $k = 1, ..., K$ products per branch, and $j = 1, ..., J$ be the MSA's in which the bank operates a branch. Then $R_{i,k,n,j}$ is the deposit rate on k^{th} product, in branch n in MSA j for bank i. And, $\bar{R}_{k,j}$ be the median MSA rate for the k^{th} product. Then the percentage of branch-products (DRA_{it}), in which a bank i enjoys a deposit rate advantage at time t is computed as:

$$DRA_{it} = \frac{\sum_{j=1}^{J} \mathbf{1}(R_{i,k,n,j} \leq \bar{R}_{k,j})}{N * K}$$

$\mathbf{1}$ is an indicator variable that takes value of 1 if the condition is met, else takes the value 0.

1.4 Results

Empirically, the effect of deposit flows on banking stability have largely been studied as the outflows of deposits in response to fundamental weakness at banks (Gorton (1988), Saunders and Wilson (1996), and Calomiris and Mason (1997)) or as a panic based run by depositors (Calomiris and Mason, 1997). Recent empirical evidence has suggested that in addition to deposit outflows, there are simultaneous inflows at failing/distressed banks (Martin et al., 2018). There is heterogeneity in depositor response to perceived insolvency risk of individual banks (Iyer, Puri, and Ryan, 2016). And depositors are rational and move their deposits from distressed to healthy banks (Egan, Hortaçsu, et al., 2017). In this section we look at some of the properties of deposit inflows, outflows, and deposit reallocation. Then I show how examining gross deposit flows provides us with valuable information on the stability of the banking system, which cannot he garnered from studying net deposit flows alone.

Magnitude and Persistence

Table 1 shows the rates and dollar amounts of aggregate inflows, outflows, and reallocation of deposits within the banking system for the 1984 - 2017 time period. The figures are based on quarterly changes in deposits at the bank-level and all dollar amounts are in December 2017 dollars. I find that the average rate of deposit inflows (POS_D) is 3.7% (or $238 bn), and ranges from 1.2% - 10.3% (or $83bn - $932bn) each quarter over the sample period. Conversely, the rate of deposit outflows (NEG_D) averages 1.1% (or $71bn), and ranges from 0.2% - 3.7% (or $12bn - $389bn) each quarter. I find that on average, deposit inflows are nearly five times as large and five times as volatile than deposit outflows.

I find a similar trend across deposit types, though the magnitude varies considerably. Core deposits have an average inflow rate of 3.9% and an outflows rate of 1%, but on average deposit inflows are nearly six times as large as deposit outflows. Large time-deposits have an average inflow rate of 7.3% and an outflows rate of 5.2%, an on average deposits inflows are only twice as large as deposit inflows. In dollar terms however, inflows of core deposits are much higher ($216bn) compared to inflows of large time-deposits ($123bn), each quarter, while outflows of core deposits ($55bn) are comparable in magnitude to outflows of large time-deposits ($50bn), attesting to the “sticky” nature of core deposits. These aggregate level deposit outflows (run-off) rates are much lower than those considered in the Basel III regulations on liquidity and stable funding (Basel III, 2013). Basel III regulations assume a run-off rate of 5% (minimum of 3%) for stable funding sources, which in my case are core deposits, and a run-off rate of 10% or higher for less stable funding sources, or in my case large time-deposits. These findings suggest that the deposit run-off rates considered in the Basel regulations may be more conservative than the run-of rates observed.

Table 1. Gross Deposit Inflows, Outflows, and Reallocation

Measure	N	Mean	St. Dev.	Min	Max	Mean	St. Dev.	Min	Max	Mean	St. Dev.	Min	Max
		Total Deposits				**Core Deposits**				**Large Time-Deposits**			
Inflows (POS_D)	135	0.037	0.017	0.012	0.103	0.039	0.026	0.011	0.245	0.073	0.029	0.019	0.158
Outflows (NEG_D)	135	0.011	0.007	0.002	0.037	0.010	0.007	0.002	0.033	0.052	0.020	0.018	0.115
Reallocation (EXC_D)	135	0.021	0.011	0.005	0.054	0.020	0.011	0.004	0.050	0.091	0.028	0.035	0.160
Entry	135	0.002	0.005	0.000	0.062	0.002	0.005	0.000	0.060	0.002	0.007	0.000	0.078
Exit	135	0.001	0.007	0.000	0.083	0.00003	0.0001	0.000	0.001	0.002	0.020	0.000	0.237
Inflows / Outflows	135	4.820	4.457	0.509	36.026	6.230	8.772	0.537	87.010	1.653	1.064	0.234	5.707
Reallocation / Outflows	135	1.972	0.132	1.017	2.000	1.979	0.118	1.073	2.000	1.808	0.364	0.467	2.000
						In 2017 Dollars ($ Billions)							
Inflows (POS_D)	135	237.74	124.96	83.84	932.80	216.42	123.72	50.11	836.41	70.63	34.36	17.82	215.96
Outflows (NEG_D)	135	71.00	46.14	12.00	389.25	55.10	31.45	7.56	157.89	50.39	24.36	18.57	207.44
Reallocation (EXC_D)	135	136.62	75.31	24.00	487.71	108.00	60.25	15.13	315.77	85.57	27.80	35.64	182.99

Note: Table 1 shows the rates and dollar amounts of deposit inflows (POS_D), outflows (NEG_D), aggregate flows (SUM_D), net flows (NET_D), and excess reallocation (EXC_D) in the banking system for the 1984 - 2017 sample period. All figures in the table are based on quarterly changes in bank-level deposits. The central fact captured by the table is that the rate of deposit inflows (3.7%) is larger than the rate of deposit outflows (1.1%). However, deposit inflows are more volatile than deposit outflows. The rate of inflows and outflows for core deposits (3.9%, and 1%) is smaller than the corresponding rates for large time-deposits (7.3%, and 5.2%), although the inflows and outflows of large time-deposits are more volatile. I also see that in addition to the simultaneous inflows and outflows, there is an excess reallocation of deposits in the banking system. Excess reallocation is the change in total deposits, in excess of the net deposit flows. Excess reallocation ranges from 0.5% - 5.4% ($24bn - $487bn) for the sample period. Additionally, we see that entries (de-novo banks) and exits (failure of merger) have little effect on aggregate deposit flow rates. All $ figures are in 2017 dollars.

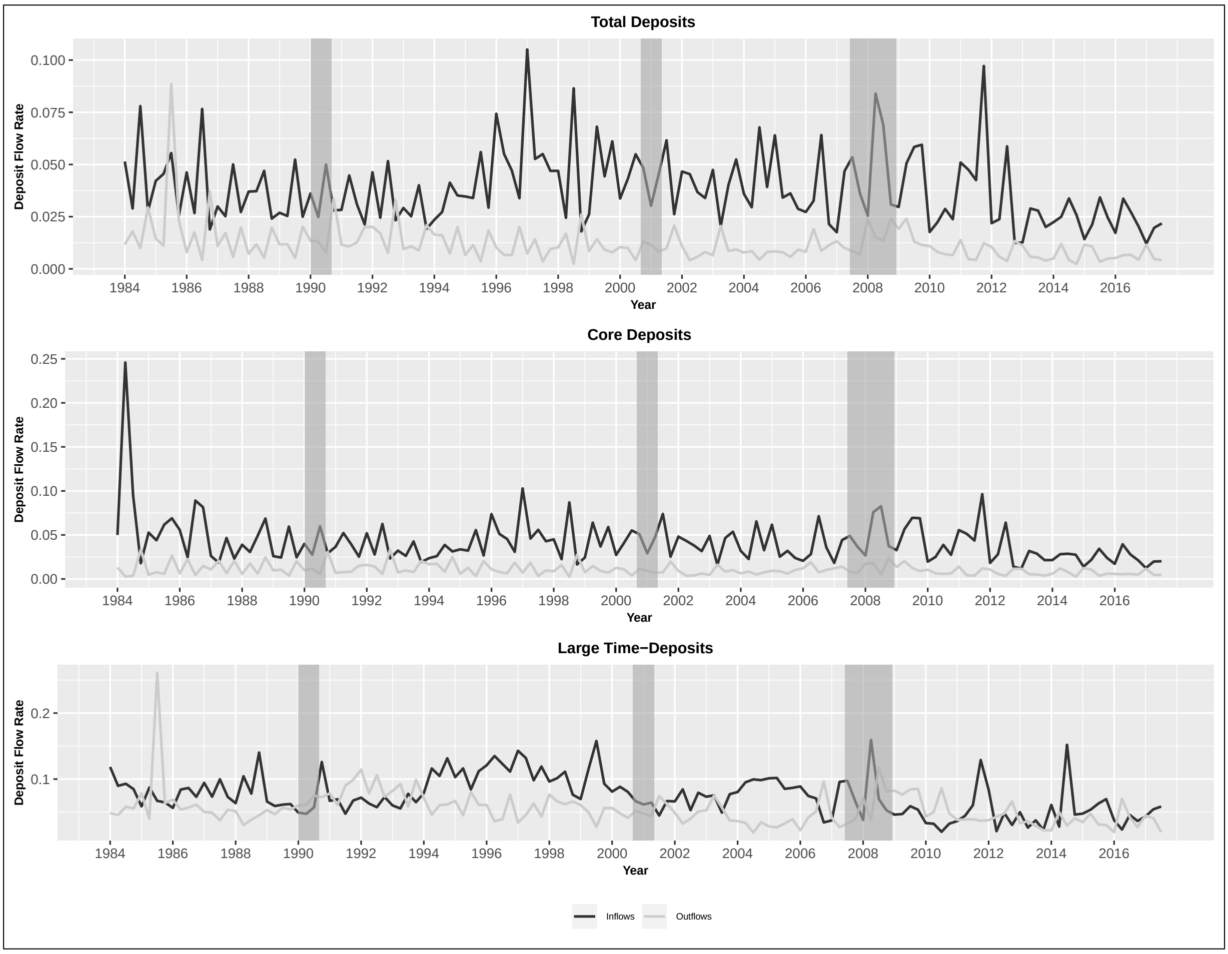

Figure 1. Simultaneous Inflows and Outflows of Deposits

Note: Figure 1 shows the rates of simultaneous inflows, outflows, and net inflows for total, core, and large time-deposits. We see that in all quarters during the sample there are simultaneous deposit inflows and outflows in the banking system. It can also be seen that during the most recent financial crisis, only large time-deposits had periods of net outflows, while there was a net inflow of core and total deposits during the same time period. However, there was a large outflow of core deposits liquidity during the 2000 - 2001 financial crisis.

Figure 1 further elaborates on the simultaneous inflows and outflows of deposits. We see that every quarter there are both deposit inflows and outflows, irrespective of whether the net inflows are positive or negative. Specifically, in periods of negative net deposit flows i.e. when the blue bars are below the 0 level line, there are deposit inflows, and in periods of net positive deposit flows, there are deposit outflows. Additionally, we see that during the most recent financial crisis (2007 - 2009) only large time-deposits experienced net outflows, while during the previous crisis (2000 - 2001) core deposits experienced net outflows. There are also simultaneous inflows and outflows even in periods of net deposit outflows. Martin et al. (2018) document a similar behavior using account-level data, and find that even at individual distressed banks there are simultaneous deposit inflows and outflows.

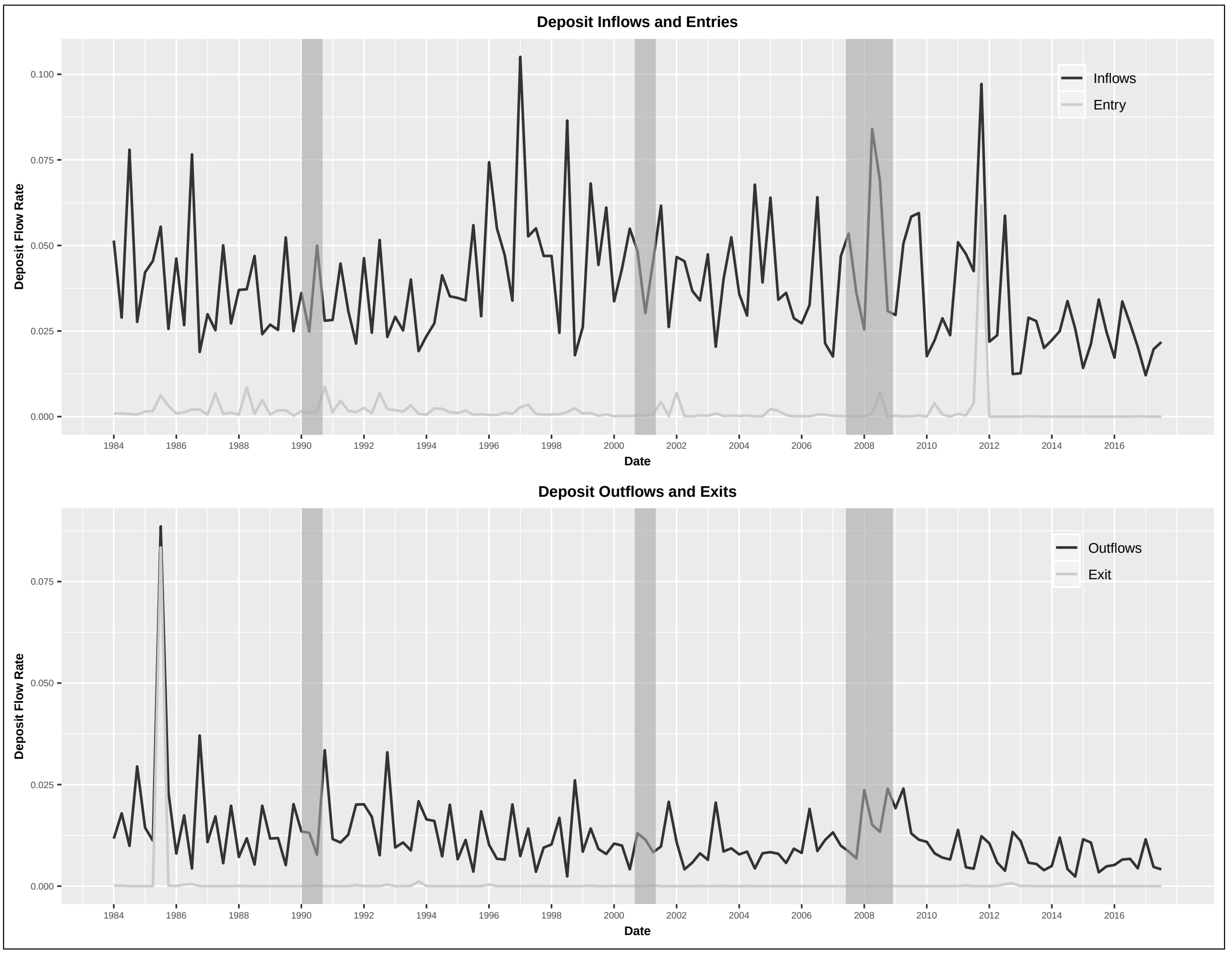

Figure 2. Inflows, Outflows, Entry and Exit

Note: Figure 2 shows the aggregate rates of deposit inflows and outflows, and the rates of inflows and outflows as a result of entries (de-novo banks) and exits (failures or mergers). I find that while there has been substantial consolidation in the industry (see Figure B as a result of mergers and bank failures, entries and exits by themselves have little effect on the rates of deposit inflows and outflows. The spike in deposit inflows as a result of entries in 2010-2011, was primarily due to thrifts' change of charter to commercial banks. The spike in outflows seen in 1985-1986 was a result of many bank failures during the Savings & Loan crisis during that time period.

These findings suggest that not only should deposit inflows be considered in evaluating the stability of the banking system, considering heterogeneity in deposit types is also important. I would also like to mention here that while the banking industry has consolidated over time (see Figure B in the Appendix), I find that the entry and exit of banks into and from the system, by itself has little impact on deposit inflows and outflows, respectively. The effect of bank entries and exits on the magnitude of deposit flows is shown in Table 1 and further elaborated in Figure 2.

To assess whether these deposit flows are due to temporary shocks to individual banks, or are structural to the banking industry, I compute measures of persistence in deposit flows. We find that deposit inflows and outflows are highly persistent. Figure 3 shows the plots of average persistence measure across time periods, and Table 2 shows the average persistence measure across deposit types.

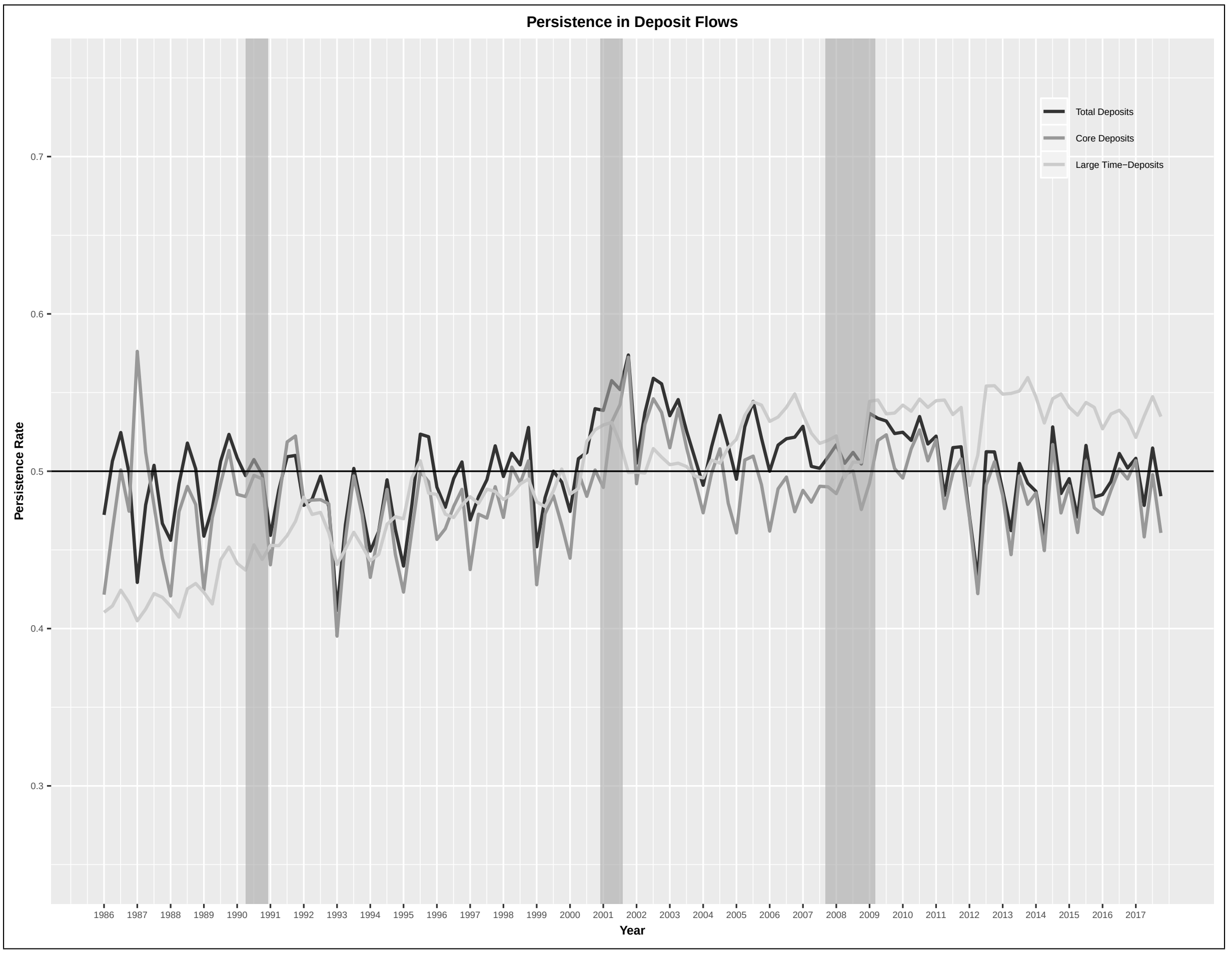

Figure 3. Persistence in Deposit Flows

Note: Figure 3 shows the persistence in deposit flows at banks across time periods. Vertical gray bars are NBER recession periods and the horizontal line is the 50% persistence level. A persistence level of 1 indicates that all deposits that came into a bank remain for one more quarter, while a persistence level of 0 indicates that none of the deposits that came into a bank remained for another quarter. I see that for most part of the sample period the persistence measure is above 0.5, indicating that on average only 50% of the deposits that come into a bank stay for another quarter.

We find that on average the persistence measure for the entire sample period is 0.61 (range 0.53 - 0.68) for total deposits, 0.57 (range 0.30 - 0.69) for core deposits, and 0.51 (range 0.42 - 0.60) for large time-deposits. This indicates that roughly only 50% - 60% of new deposits stay with the bank for an additional quarter, while the remaining deposits either leave the banking system or are redistributed amongst the banks. This further suggests that both deposit inflows and outflows are innate to the each bank and hence both should be considered in designing regulations on liquidity and stable funding.

Table 2. Persistence Measures - Summary Statistics

	Total Deposits	Core Deposits	Large Time-Deposits
Mean	0.501	0.486	0.497
St. Dev.	0.028	0.029	0.042
Min	0.412	0.395	0.405
Max	0.574	0.576	0.560

Note: Table 2 shows that roughly only 50% of deposits that enter a bank remain at the bank for one more quarter, while the rest either leave the banking system or are reallocated amongst other banks. This further indicates that there is substantial reallocation of deposits in the banking system.

In addition to deposit inflows and outflows into the banking system, there is also a reallocation amongst banks. This reallocation (EXC_D) of deposits within the banking system which averages around 2.1% (or $136bn), and ranges from 0.5% - 5.4% (or $24bn - $487bn) each quarter. The reallocation rate for core deposits is around 2%, while the reallocation rate for large time-deposits is much higher at around 9.1%. However, the average ratio of reallocation to outflows is around 1.8-1.9 across deposit types. This ratio suggests that for every $1 that leaves the banking system, $1.9 is reallocated amongst banks. Reallocation suggests that depositors are rational, and while some depositors may withdraw their depositors from the banking system completely, nearly twice choose to move their deposits to other banks which provide them with a greater utility.

Contemporaneous and Cross-Correlations

Martin et al. (2018) find that when uninsured depositors leave a failing bank they also with their insured deposits that the banks. They also find that at the failing bank they study outflow of uninsured deposits was accompanied with an inflow of insured deposits, albeit from different depositors via internet listing services. To further examine whether such patterns are unique only to failing banks or a common occurrence in the banking system, I examine contemporaneous and cross-correlations between deposit inflow and outflows, across deposit types. I first examine the correlations in deposit inflows and outflows at the aggregate level.

Table 3. Correlations - Core Deposits and Large Time-Deposits

	POS_{CORE}	NEG_{CORE}	POS_{LTD}	NEG_{LTD}
POS_{CORE}	1			
NEG_{CORE}	-0.24**	1		
POS_{LTD}	0.26**	0.23**	1	
NEG_{LTD}	0.11	0.14	-0.16	1

Note: Table 3 shows the correlations between deposit inflows and outflows for core deposits and large time-deposits. From the table we see that outflows of core deposits are associated with lower inflows of core deposits. However, the outflows of core deposits are also associated with inflows of large time-deposits, suggesting a substitution effect in funding sources. We also see that inflows of core and large time-deposits are also also positively correlated with each other, but outflows are not significantly correlated. This suggests that while there is a run-in of different types of depositors simultaneously, the run-offs don't happen simultaneously.

Table 3 shows the correlations between deposit inflows and outflows for core deposits and large time-deposits. From the table we see that outflows of core deposits are associated with lower inflows of core deposits ($\rho(POS_{Core}, NEG_{Core}) = -0.24^{**}$), or an inflow of core deposits leads to a lower outflow of core deposits.Outflows of core deposits are also associated with inflows of large time-deposits (($\rho(NEG_{Core}, POS_{LTD}) = 0.23^{**}$), suggesting some degree of substitution in funding sources. I however do not find any evidence that outflows of large time-deposits are associated with inflows of core deposits (($\rho(NEG_{LTD}, POS_{Core}) = 0.11$). We also see that inflows of core and large time-deposits are also also positively correlated with each other (($\rho(POS_{Core}, POS_{LTD}) = 0.26^{**}$), but outflows are not significantly correlated (($\rho(NEG_{Core}, NEG_{LTD}) = 0.14$). This suggests that while there is a run-in of different types of depositors simultaneously, the run-offs don't happen simultaneously, which is essential in understanding depositor run-offs and bank stability.

I then examine the correlations between deposit inflows and outflows by various levels of insolvency risk, across deposit types. I use levels of equity capital, Non-Performing Assets (NPA's) and Charge-Offs (CO's) to identify insolvency risk.

Table 4. Correlations - By Insolvency Risk

	$\rho(POS_{CORE},POS_{LTD})$	$\rho(POS_{CORE},NEG_{LTD})$	$\rho(NEG_{CORE},POS_{LTD})$	$\rho(NEG_{CORE},NEG_{LTD})$
High Capital	0.89***	−0.07	−0.09	0.22***
Low Capital	0.23***	−0.07	0.19**	0.19**
High NPA	0.59***	0.21**	−0.15*	0.01
Low NPA	0.42***	−0.01	0.04	−0.03
High CO	0.33***	0.04	0.01	0.14*
Low CO	0.33***	0.14*	0.14	0.03

Note: Table 4 shows the correlations between deposit inflows and outflows for core deposits and large time-deposits, by various levels of insolvency risk. NPA is Non-Performing Assets / Total Loans, and CO is Charge-Offs/Non-Performing Assets. We see that while inflows of core and large time-deposits are positively correlated across risk categories, simultaneous outflows are indifferent to capital levels, but are most likely in banks with high Charge-Offs. We also see that the substitution effect between core deposits and large time deposits is most evident in banks with low capital, high levels of NPA's, and low Charge-Offs.

Table 4 shows that while inflows of core and large time-deposits are positively correlated across risk categories, simultaneous outflows are indifferent to capital levels, but are more likely in banks with high Charge-Offs. We also see that the substitution effect between core deposits and large time deposits is most evident in banks with low capital, high levels of NPA's, and low Charge-Offs. These findings suggest that the substitution effect between core deposits and large time-deposits is largely prominent at banks facing greater insolvency risk, similar to the findings by Martin et al. (2018).

I also examine non-contemporaneous or cross-correlations between deposit inflows and outflows, across deposit types. From Figure 4 we see that core deposit inflows are positively correlated with large time-deposit inflows, both contemporaneously and with future inflows.

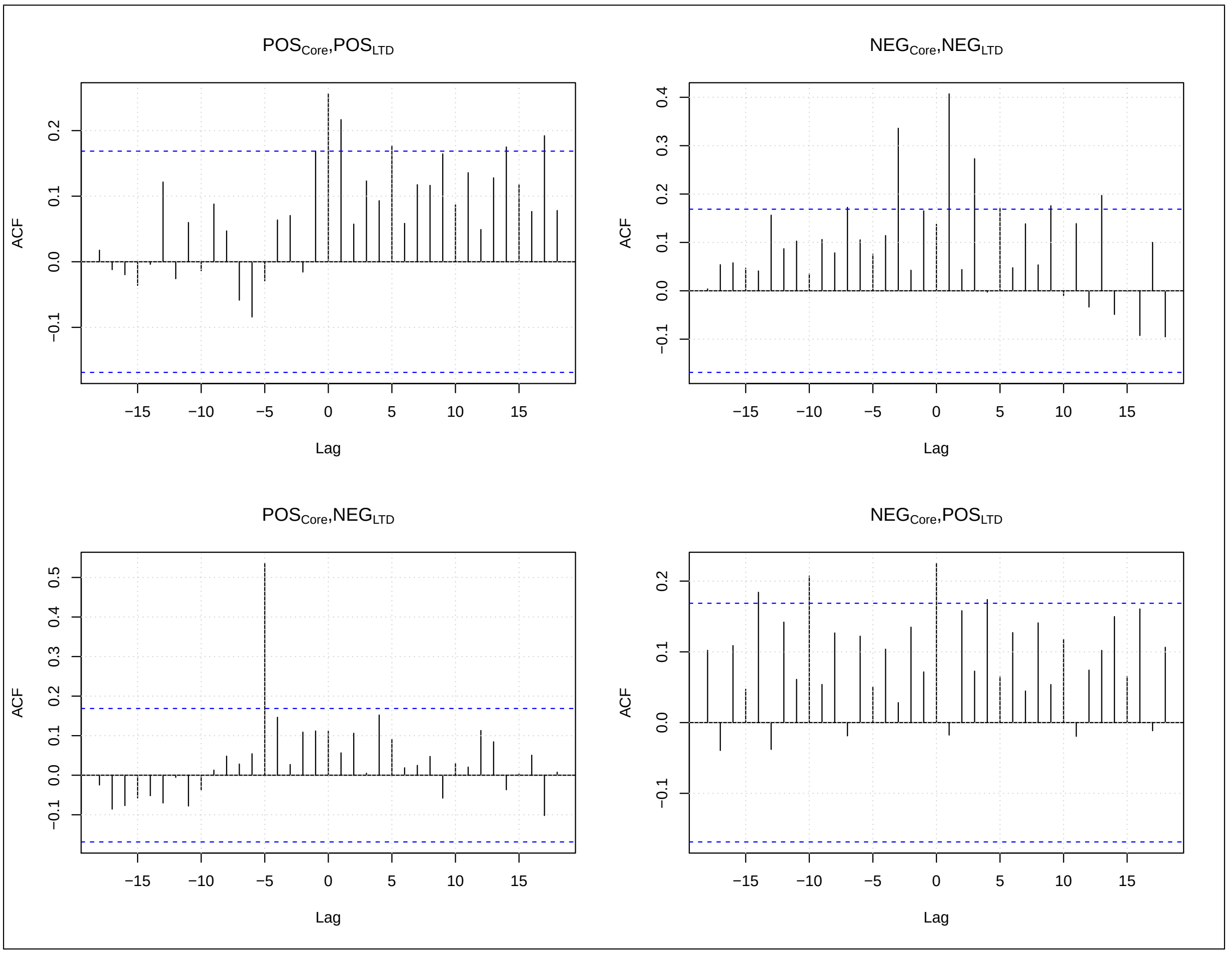

Figure 4. Cross-Correlation - Core Deposits and Large Time-Deposits

Note: Figure 4 shows the cross correlation plots between deposit inflows/outflows for core deposits and large time-deposits. We see that core deposit inflows are positively correlated with large time-deposit inflows, both contemporaneously and with future inflows. Deposit outflows for core deposits and large time-deposits are also correlated with each other but non-contemporaneously, suggesting that both core deposits and large time-deposits don't necessarily the leave the banking system at the same time. The cross-correlations between inflows/outflows of core and large time-deposits suggest the presence of a substitution effect between core deposits and large time-deposits, albeit non-contemporaneously. Outflows of large time-deposits are followed by inflows of core deposits after a period of 5 quarters. Inflows of large time-deposits affect the outflows of core deposits both with a lead and lag.

Deposit outflows for core deposits and large time-deposits are also correlated with each other but non-contemporaneously, suggesting that both core deposits and large time-deposits don't necessarily the leave the banking system at the same time. The cross-correlations between inflows/outflows of core and large time-deposits suggest the

presence of a substitution effect between core deposits and large time-deposits, albeit non-contemporaneously. Outflows of large time-deposits are followed by inflows of core deposits after a period of 5 quarters. Inflows of large time-deposits affect the outflows of core deposits both with a lead and a lag.

Economic and Market Conditions

I next examine the effect of macroeconomic and market conditions on deposit flows. Table 5 shows the effect of economic and market conditions on deposit flows. I find that the aggregate rate of deposit inflows increases during periods of high stock market returns, and the rate of deposit outflows decreases during periods of high economic activity. Across deposit types, I find that the increase in the inflow of deposits is primarily due increases in core deposits inflows. These findings suggest the presence of a wealth effect, where high economic activity is accompanied by increased lending by banks, and thus an increase in the demand for funds. Martin et al. (2018) find a similar result in their study.

On the other hand, the rate of inflows of large time-deposits increases during periods of high market volatility, suggesting that depositors view banks as "safe havens" during periods of market uncertainty. These findings are consistent with (Acharya and Naqvi, 2012) and (Gatev and Strahan, 2006),and could potentially be attributed to the liquidity and safety of bank deposits during economic contractions. So while investors can choose bank deposits as means to earn higher returns vis-a-vis other storage technologies (Allen et al., 2015), bank deposits may be viewed as a safe storage mechanism rather than investments, especially during periods of economic uncertainty.

High economic activity also affects core deposits and large time-deposits differently. For core deposits, while both the rate of deposit inflows and outflows decrease, for large time-deposits only the rate of outflows decreases. Large time-deposits are also more sensitive to changes in the benchmark rate of return (the federal funds rate), compared to core deposits. While Egan, Hortaçsu, et al. (2017) suggest that all deposits are price inelastic, I find that increases in the federal funds rate leads to higher inflows and lower

Table 5. Deposit Flows - Macro Variables

	Total Deposits		**Core Deposits**		**Large Time-Deposits**	
	POS_D	NEG_D	POS_D	NEG_D	POS_D	NEG_D
GDP Growth Rate	−0.0003	0.001*	−0.0005	0.0004	0.001	0.0005
	(0.001)	(0.0003)	(0.001)	(0.0003)	(0.002)	(0.001)
Fed Funds Rate	0.0004	−0.0005	−0.001	−0.0001	0.006***	−0.003***
	(0.001)	(0.0003)	(0.001)	(0.0003)	(0.002)	(0.001)
CEA Index	−0.0002	−0.0002***	−0.0003**	−0.0001**	−0.0001	−0.001***
	(0.0002)	(0.00005)	(0.0002)	(0.00005)	(0.0002)	(0.0001)
Lead Index	−0.005	−0.003***	−0.006**	−0.002*	0.001	−0.007**
	(0.003)	(0.001)	(0.003)	(0.001)	(0.005)	(0.003)
VIX Change	0.011	0.002	0.008	0.004	0.032***	−0.010
	(0.008)	(0.002)	(0.008)	(0.002)	(0.012)	(0.007)
S&P 500 Returns	0.062*	−0.003	0.075**	−0.001	0.056	0.006
	(0.035)	(0.011)	(0.036)	(0.011)	(0.054)	(0.034)
Constant	0.058***	0.031***	0.076***	0.022***	0.065**	0.171***
	(0.016)	(0.005)	(0.017)	(0.005)	(0.025)	(0.016)
Observations	111	111	111	111	111	111
Adjusted R^2	0.042	0.207	0.071	0.113	0.280	0.389

*p<0.1; **p<0.05; ***p<0.01

Note: Table 5 shows the effect of macro-economic and market conditions on deposit inflows and outflows, across deposit types. I find that the aggregate rate of deposit inflows increases during periods of high stock market returns, and the rate of deposit outflows decreases during periods of high economic activity. Across deposit types, I find that the rate of inflows of core deposits increases during periods of high stock returns, suggesting a wealth effect. On the other hand, the rate of inflows of large time-deposits increases during periods of high market volatility, suggesting that depositors view banks as "safe havens" during periods of market uncertainty. High economic activity also affects core deposits and large time-deposits differently. For core deposits, while both the rate of deposit inflows and outflows decrease, for large time-deposits only the rate of outflows decreases. Large time-deposits are also more sensitive to changes in the benchmark rate of return (the federal funds rate), compared to core deposits. Increases in the federal funds rate leads to higher inflows and lower inflows for large time-deposits, while there is no such effect observed for core deposits. These findings further elaborate on the sensitivity of different deposit types to changes in macro economic and market conditions, and benchmark rates of return.

inflows for large time-deposits, while there is no such effect observed for core deposits. These findings further elaborate on the sensitivity of different deposit types to changes in macro economic and market conditions, which should be taken into consideration when evaluation deposit flows and bank stability.

Cross-Sectional Variation

We have seen that the magnitude and volatility of aggregate deposit inflows and outflows differs substantially. Deposit flows is a persistent feature for all banks, and flows vary with economic and market conditions. I now explore the variation in deposit flows, the magnitude of inter-group deposit flows, and the direction of deposit flows across bank size groups.

Table 6 shows the rates of deposit inflows, outflows, and the reallocation of deposits across bank size groups. Banks as classified into size groups each quarter based on total assets and deposit flow measures are computed as percentage of total group deposits.[6] We see that the very largest banks (total assets in the top 1 percentile) have higher rates of deposit inflows (4.2%) compared to inflow rates of 3.0% - 3.9% in the other groups. The largest banks also have a comparable-to-lower rate of deposit outflows (1.2%) compared to the 1.1%-2.6% rate of outflows for other groups. The these findings are similar for both core and large time-deposits.

The ratio of deposit inflows to outflows decreases monotonically from the largest to the smallest bank. For every $1 of outflows, the largest banks attract $9, while the smallest banks only attract roughly $2.6. On the other hand the the ratio of deposit reallocation to outflows increases monotonically from the largest to the smallest bank. Similarly for every $1 in outflow of core deposits and large time-deposits, the largest bank attract $11.8 and $1.9 respectively. On the other hand, for every $1 in outflow of core and large time deposits, the smallest bank attract only $2.5 and $1.6, respectively. For every $1 of outflow for the largest banks, $1.89 are reallocated amongst the largest banks, while for

[6] My findings are similar if instead of computing rates as percentage of total group deposits I use aggregate deposits in the banking system.

Table 6. Deposit Flows - By Bank Size

Measure	N	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
		Total Deposits		**Core Deposits**		**Large Time-Deposits**	
		Largest Banks (Top 1 Percentile, Mean Size=$83.1bn, Median Size=$28.5bn)					
Inflows (POS_D)	135	0.042	0.029	0.046	0.037	0.076	0.042
Outflows (NEG_D)	135	0.012	0.012	0.012	0.018	0.057	0.031
Reallocation (EXC_D)	135	0.021	0.016	0.018	0.015	0.085	0.033
Inflows / Outflows	135	9.093	15.201	11.842	19.647	1.930	1.857
Reallocation / Outflows	135	1.892	0.311	1.902	0.323	1.686	0.510
		Large Banks (1^{st}% - 10^{th}%'tile, Mean Size=$2.71bn, Median Size=$1.47bn)					
Inflows (POS_D)	135	0.039	0.016	0.044	0.028	0.076	0.032
Outflows (NEG_D)	135	0.026	0.022	0.014	0.016	0.054	0.037
Reallocation (EXC_D)	135	0.025	0.014	0.023	0.012	0.095	0.038
Inflows / Outflows	135	4.460	4.826	5.987	12.577	1.739	1.146
Reallocation / Outflows	135	1.979	0.132	1.972	0.183	1.897	0.272
		Average Sized Banks (10^{th}% - 25^{th}%'tile, Mean Size=$430mn, Median Size=$394mn)					
Inflows (POS_D)	135	0.032	0.011	0.035	0.021	0.064	0.024
Outflows (NEG_D)	135	0.011	0.004	0.015	0.025	0.043	0.020
Reallocation (EXC_D)	135	0.021	0.008	0.022	0.008	0.077	0.020
Inflows / Outflows	135	3.507	2.253	4.244	10.609	1.745	0.970
Reallocation / Outflows	135	1.989	0.068	1.976	0.181	1.889	0.261
		Median Banks (25^{th}% - 50^{th}%'tile, Mean Size=$181mn, Median Size=$166mn)					
Inflows (POS_D)	135	0.030	0.010	0.033	0.019	0.063	0.023
Outflows (NEG_D)	135	0.011	0.004	0.016	0.030	0.043	0.022
Reallocation (EXC_D)	135	0.022	0.006	0.024	0.008	0.078	0.030
Inflows / Outflows	135	3.083	1.919	3.461	7.989	1.666	0.863
Reallocation / Outflows	135	1.976	0.118	1.950	0.229	1.890	0.261
		Small Banks (< 50^{th}%'tile, Mean Size=$61mn, Median Size=$55mn)					
Inflows (POS_D)	135	0.033	0.012	0.035	0.019	0.072	0.028
Outflows (NEG_D)	135	0.014	0.004	0.019	0.030	0.050	0.022
Reallocation (EXC_D)	135	0.028	0.007	0.030	0.008	0.095	0.038
Inflows / Outflows	135	2.646	1.759	2.587	2.841	1.589	0.755
Reallocation / Outflows	135	1.969	0.138	1.920	0.247	1.924	0.187

Note: Table 6 shows the deposit flow measures for total, core, and large time-deposits across banks of different size groups. I see that the largest banks have higher rates of gross and net deposit inflows compared to other groups, while the other groups have higher rates of excess deposit reallocation, and this effect is consistent across deposit types. We also see that there is substantial excess reallocation of deposits across bank size groups. So while as a group the largest banks may be producing the most liquidity, there is considerable variation in the deposit flow rates. even within banks in the same group.

the smallest banks \$1.96 are reallocated. Similarly, for core and large time-deposits, for every \$1 of outflow at the largest banks, \$1.9 and \$1.7 are reallocated amongst banks of similar size, while \$1.9 are reallocated amongst the smallest banks.

These findings suggest that the largest banks both attract and retain more deposits compared to the smaller banks, for every dollar of deposit outflow. Since the largest banks also have the most number of branches, these higher ratios of deposit inflows to outflows at the largest banks suggests the importance of branch networks, not only in in their ability to attract deposits, but also in reducing information asymmetry and monitoring costs (Aguirregabiria et al., 2017), and thus retaining more deposits. This monotonic trend in the ratios of deposit inflows-to-outflows and reallocation-to-outflows to cannot be captured with deposit growth rates, or deposit market share alone, and is thus valuable in understanding the funding risks faced by community banks vis-a-vis larger banks.

Deposits are not only reallocated amongst banks in similar size groups, but also across groups. I find that nearly 60% of the reallocation of core deposits is inter-group, while for large time-deposits it is only 30% , the rest being intra-group. We saw that while the rates of reallocation of large time-deposits is higher than that for core deposits (9.1% vs. 2%, refer Table 1), large time-deposits are largely reallocated across banks of similar size. This suggests that the reallocation of large time-deposits is largely due to heterogeneity in bank-level dynamics within similar size groups, and not so much as differences in banking practices between the largest and smaller banks.

Table 7. Deposit Flows Across Bank Size-Groups

	N	Mean	St. Dev.	Min	Max
	Largest Banks ⟷ Large Banks				
Total Deposits	135	0.446	0.244	0.037	0.915
Core Deposits	135	0.407	0.253	0.019	0.931
Large Time-Deposits	135	0.695	0.186	0.272	0.990
	Largest Banks ⟷ Average Banks				
Total Deposits	135	0.441	0.263	0.049	0.954
Core Deposits	135	0.406	0.275	0.021	0.974
Large Time-Deposits	135	0.674	0.211	0.161	0.992
	Largest Banks ⟷ Median Banks				
Total Deposits	135	0.443	0.271	0.043	0.971
Core Deposits	135	0.410	0.283	0.022	0.979
Large Time-Deposits	135	0.673	0.215	0.150	0.987
	Largest Banks ⟷ Small Banks				
Total Deposits	135	0.447	0.275	0.040	0.974
Core Deposits	135	0.413	0.286	0.030	0.973
Large Time-Deposits	135	0.674	0.220	0.134	0.989

Note: Table 7 shows the index of inter-group deposit flows between the very largest banks and banks of other sizes. The index is constructed using the methodology of (Davis and Haltiwanger, 1992). An index value of 0 indicates that all flows are inter-group, whereas an index value of 1 indicates that all flows are intra-group. Index value greater than 0.5 indicates that flows are largely intra-group, while those below 0.5 indicate that flows are largely inter-group. We can see that for the sample period, on an average, around 55-60% of the flow of total and core deposits are inter-group, and the remaining 40-45% are intra-group. However, for large time-deposits, we see that around 67-70% of all deposit flows are intra-group, and only 30-33% are inter-group. In Table 6 we saw that there is considerable variation in deposit flow rates, even within banks in the same size groups, here we see that this heterogeneity in the liquidity production promotes the flow of deposits across banks in different size groups. While we can see that deposits flows across banks of different size groups, the index does not tell us on the direction of deposit flows.

These reallocation figures however do not give us the direction of deposit flows. I develop on the methodology used by Meller and Metiu (2017) to measure synchronization of economic cycles across countries, to ascertain the direction of deposit flows.

Table 8. Reallocation Of Deposits - Very Largest Banks Vs. All Other Banks

	Mean			*Trend*		
	Total Deposits	**Core Deposits**	**Large Time-Deposits**	**Total Deposits**	**Core Deposits**	**Large Time-Deposits**
Full Sample	-0.0208	-0.0080	-0.0645	0.002^{***}	0.002^{***}	-0.0002
(Q2,1984 - Q4,2017)	(0.9508)	(0.7406)	(1.0000)	(0.0003)	(0.0003)	(0.0002)
Pre Reigle-Neal	-0.1082	-0.0995	-0.0708	-0.006^{***}	-0.002	-0.007^{***}
(Q2,1984 - Q3,1994)	(1.0000)	(1.0000)	(0.9999)	(0.002)	(0.002)	(0.001)
Post Reigle-Neal	0.0163	0.0308^{**}	-0.0618	0.003^{***}	0.003^{***}	-0.00005
(Q3,1994 - Q4,2017)	(0.1208)	(0.0142)	(1.0000)	(0.0004)	(0.0004)	(0.001)
Post Gramm–Leach–Bliley	0.062^{***}	0.0800^{***}	-0.0756	0.002^{***}	0.002^{***}	0.001^{**}
(Q1,2000 - Q4,2017)	(< 0.0001)	(< 0.0001)	(1.0000)	(0.001)	(0.001)	(0.0003)

Note: While Table 7 showed us that here is considerable reallocation of deposits across banks of different sizes, it did not tell us anything on the direction of these deposit flows. To overcome this limitation I construct a directionality measure to ascertain the direction of deposit reallocation between the largest banks and the other banks. Table 8 shows the mean and the trend in direction of deposit reallocation across time periods. The direction is computed as flows between small banks and the very largest banks. A net positive value indicates that deposits are reallocated from smallest banks to the largest banks, while a net negative value indicates otherwise. We see that post Reigle-Neal (Q3,1994), there is a net reallocation of total and core deposits from smaller to the largest banks and this effect becomes even stronger post Gramm–Leach–Bliley, 1999 (GLB). We also see that the overall trend is is positive post Riegle-Neal for all deposit types. One possible explanation for this effect could be the "economies of scale" enabled by Riegle-Neal which allowed banks to acquire other banks and operate across state boundaries and become largeer, and the "economies of scope" enabled by GLB that allowed banks to engage in investment banking and insurance business in additional to commercial banking activities.

Table 8 show the mean and trend in directionality index for deposit reallocation. Positive values indicate a reallocation of deposits from smaller to the largest banks, negative values indicate otherwise. We see that for total and core deposits, on average, deposits are reallocated from small banks to large banks, and this effect is more pronounced post Riegle-Neal (RN) and post Gramm-Leach-Bliley (GLB). Directionality index is 0.0620*** for total deposits post GLB. For core deposits its is 0.0308** post RN, and 0.0800*** post GLB. I do not see any such evidence of deposit reallocation for large time-deposits. I also see that the trend in the direction of deposit reallocation is positive for the whole sample period, except for the pre Riegle-Neal period during which it was negative. One possible explanation for this effect could be the "economies of scale" enabled by RN which allowed banks to acquire other banks and operate across state boundaries and become larger, and the "economies of scope" enabled by GLB that allowed banks to engage in investment banking and insurance business in additional to commercial banking activities. Both the scale and scope effects allowed the banks to establish relationships with depositors, and hence the effect is evident more for core deposits which are more relationship based compared to large time-deposits. Combining the findings on the rates of inflows and outflows across bank size groups with the magnitude and direction of deposit outflows at smaller banks, these findings suggest that smaller banks have been losing deposits to the largest banks, and may be more vulnerable to deposit outflows and funding shortages compared to their larger counterparts.

Bank Specific Attributes Affecting Deposit Flows

In the preceding section(s), I established that there are simultaneous inflow and outflow of deposits, these flows are large in magnitude, they vary with economic and market conditions, and across bank size groups. We found that these inflows, outflows, and reallocation of deposits is a persistent feature of the banking system. This section explores other attributes that could potentially explain deposit flows. I examine the ways in which depositors derive utility from bank deposits, and how each of these factors affects deposit flows. I consider three main factors, as mentioned in Egan, Hortaçsu, et al. (2017), namely deposit rates offered, insolvency risk, and ability to effectively utilize deposits. Each of these are discussed in the sections below.

Deposit Rate Advantages

To interpret my results I use the framework of DeAngelo and Stulz (2015), who suggest that banks that enjoy deposit rate advantages over their peers should have lower leverage and consequently lower (higher) rates of deposit inflows (outflows). Deposit rate advantage is computed as the percentage of branch-products in which a given bank offers deposit rates lower than the median MSA rate for that product. Table 9 shows the rates of deposit inflows, outflows, and reallocation in the highest and the lowest decile groups ranked on deposit rate advantages. I find that deposit inflows for the banks in the highest group are nearly 25% compared to to banks in the lowest decile group. Similarly core deposit inflows are nearly 23% lower, and large time-deposit inflows are 15% lower. Deposit outflows at banks in the highest decile are nearly 38% than banks in the lowest decile. Similarly outflows are 20% and 56% higher for core and large time-deposits respectively. We also see that rates of reallocation are higher for the banks in the highest decile, and this is consistent across deposit types.

As another measure, I scale the deposit rate advantage measure computed earlier with the banks' net interest margin. This enables us to examine whether the high (low) deposit rate advantage eventually results in higher (lower) interest margins. However, here we see that while deposit inflows are lower at banks in the highest decile, outflows and rates of reallocation are also lower compared to banks in the lowest decile, and this is consistent across deposit types.

Table 9. Deposit Flow Measures: Bank Attributes

	Total Deposits			Core Deposits			Large Time-Deposits		
	POS_D	NEG_D	EXC_D	POS_D	NEG_D	EXC_D	POS_D	NEG_D	EXC_D
	Deposit Rate Advantage								
High	0.047	0.011	0.021	0.047	0.012	0.023	0.075	0.039	0.061
Low	0.062	0.008	0.016	0.061	0.010	0.019	0.088	0.025	0.046
High / Low	0.75	1.38	1.31	0.77	1.20	1.21	0.85	1.56	1.33
	Deposit Rate Advantage/ Interest Margin								
High	0.051	0.009	0.015	0.051	0.010	0.016	0.079	0.037	0.053
Low	0.054	0.011	0.018	0.055	0.010	0.017	0.086	0.043	0.055
High / Low	0.94	0.81	0.83	0.93	1.00	0.94	0.92	0.86	0.96
	NPA								
High	0.035	0.023	0.034	0.040	0.022	0.034	0.055	0.060	0.073
Low	0.061	0.013	0.023	0.066	0.013	0.024	0.103	0.146	0.071
High / Low	0.57	1.77	1.48	0.60	1.69	1.42	0.53	0.41	1.03
	Capital Ratio								
High	0.062	0.025	0.041	0.068	0.024	0.039	0.094	0.062	0.089
Low	0.046	0.013	0.023	0.049	0.013	0.024	0.074	0.047	0.070
High / Low	1.35	1.92	1.78	1.38	1.85	1.63	1.27	1.32	1.27

Note: Table 9 shows the rates of deposit inflows, outflows, and excess reallocation based on bank attributes, across deposit types. High group represents banks in the top decile and Low group is for banks in the bottom decile for that measure. Deposit Rate Advantage is computed as the percentage of branch-products where a bank offers deposit rates lower than the median rate for a particular product in a given MSA. NPA is the ratio of Non-Performing Assets / Total Loans, and Equity Capital Ratio is Total Equity Capital / Total Assets. We see that rates of deposit inflows is nearly 15% - 25% lower for banks that have a high deposit rate advantage, while deposit outflows are nearly 20% - 56% higher. However, when the deposit rate advantage is scaled by interest margin, we see that while rates of inflow are lower for banks in the highest decile, the rates of outflows are also lower. We also see that the rates of inflows are nearly 40% - 47% lower at banks with high NPA, while deposit outflows are 69% - 77% higher. For large time-deposits however, the rate of outflows is lower for banks in the highest decile of NPA's. Across capital levels, we see that both inflows, outflows, and the rates of excess reallocation are higher for banks in the highest decile.

I further compute the directionality measure for deposit flows based on deposit rate advantages. If indeed depositors are rational and return seeking, ceteris paribus one should expect to see deposits flow from banks offering lower deposit rates (higher deposit rate advantage) to banks with higher deposit rates (lower deposit rate advantages). Table 10 shows the direction of deposit flows. As one would expect the directionality index is negative, indicating that deposits move from banks in the higher group to banks in the lower group. The directionality index is -0.0783^{***} for total deposits, -0.0493^{***} for core deposits, and -0.1269^{***} for large time deposits. When considering the scaled version of deposit rate advantage, the results are only significant for large time-deposits, which have a directionality index of -0.0155^{*}.

My findings are consistent with the model of DeAngelo and Stulz (2015) and show that depositors are rational and return seeking, and thus deposits are reallocated to banks which provide depositors with a higher utility via higher deposit rates.

Insolvency Risk

Utility derived by depositors from bank also depends from the banks' insolvency risk. While uninsured depositors would be most at risk since they would lose their deposits in case of a bank failure, even insured depositors would face some loss in utility from the extinguishment of depositor-bank relationship. Saunders and Wilson (1996) find that informed depositors can ex-ante identify failing and non-failing banks and withdraw their deposits in anticipation of a bank failure. Egan, Hortaçsu, et al. (2017) echo a similar sentiment that depositors are fully rational and move their deposits from distressed banks to healthy banks.

I examine whether aggregate deposit flows are affected by banks' *"unconditional"* insolvency risk. I measure the *"unconditional"* insolvency risk as the ratio of Non-Performing Assets (NPA's) / Total Loans.[7] Heitz and Narayanamoorthy (2018) suggest that NPA's are a good proxy for a timely measure of a banks' probability of default. Moreover, a high level of NPA's as percentage of total loans indicates that the bank may sooner or later face the risk of insolvency.

[7] I stress on the word *"unconditional"* since the actual insolvency risk is more likely to be determined by the level of NPA's, conditional on the amount of loan loss reserves and equity capital.

Table 9 show the rates of deposit inflows, outflows, and reallocation for groups in the highest and lowest deciles of their NPA ratio. I find that deposit inflows at banks in the highest decile are nearly 43% lower and outflows are nearly 77% compared to banks in the lowest decile. Trend are similar for core deposits, where inflows are 40% lower and outflows are 69% higher, and for large time-deposits where inflows are 47% lower and outflows are 40% higher. Deposit reallocation rates are 48%, 42%, and 3% higher for banks in the highest decile, for total, core, and large time-deposits respectively.

I also examine the direction of deposit flows. If depositors can perceive insolvency risk at banks, one should expect to see negative values for directionality index. From Table 10 we see that on average deposits are reallocated from banks in the highest decile to banks in the lowest decile of NPA ratio. Directionality index is -0.1923^{***} for total deposits, -0.1573^{***} for core deposits, and -0.1351^{***} for large time-deposits.

My findings demonstrate that depositors are informative and hence the lower (higher) rates of inflows (outflows) at banks in the highest decile on NPA's. We also see that depositors move their deposits from banks that have higher insolvency risk to banks with lower insolvency risk, suggest some evidence of market discipline.

Equity Capital

I next examine the effect of the level of equity capital on deposit flow rates. In addition to deposit rates and insolvency risk, depositors also derive utility from how well the bank is able to use these deposits to generate returns sufficient enough to repay the depositors (Egan, Hortaçsu, et al., 2017). Equity capital can either aid in this process by reducing insolvency risk, which is the "risk absorption" hypothesis or it could hinder this process by reducing banks' incentives to screen and monitor its borrowers, which is the "financial fragility crowding-out" hypotheses.[8]

Table 9 shows the rates of deposit inflows, outflows, and reallocation for banks in

[8]The terms "risk absorption" hypothesis and "financial fragility crowding-out" hypothesis have been borrowed from (Berger and Bouwman, 2009).

the highest and lowest deciles ranked according to level of equity capital. I find that on average deposit inflows are nearly 35% higher at banks in the highest decile, and this percentage varies from 38% for core deposits to 27% for large time-deposits. I also see that deposit outflows are nearly 92% higher and deposit reallocation is nearly 78% higher for banks in the highest decile. The findings lend support to the "risk absorption" hypothesis that equity capital reduces banks' insolvency risk and consequently banks with higher equity capital have higher rates of deposit inflows and reallocation. However, the high rates of deposit outflows also suggest that high equity levels hinder a banks' screening and monitoring ability, consistent with the "financial fragility crowding out" hypothesis.

Table 10 shows the directionality index for deposit reallocation. We see that on average, deposits are reallocated from banks in the highest decile to banks in the lowest decile. Directionality index is -0.0680^{***} for total deposits, -0.0755^{***} for core deposits, and -0.0325^{***} for large time-deposits. The directionality measure lends support to the "financial fragility crowding-out" hypothesis, suggesting that lower capital levels aid banks' screening and monitoring roles, and hence deposits are reallocated from banks with higher levels of equity capital to those with lower levels.

My findings are consistent with both the "risk absorption" and the "financial fragility crowding-out" hypotheses. One possible explanation for these contradictory results is that both leverage and equity capital ratios have regulatory upper and lower bounds, respectively. Another aspect could be that minimum required regulatory capital is computed on an assets' risk weight, which may or may not have the same effect on deposit flows, than if it were based on the assets liquidity creation weight. Furthermore, while theoretically a bank could obtain deposits as desired, regulatory interventions could prevent the bank from obtaining certain kinds of deposits.[9]

[9] For example, a bank that is below the "Well Capitalized" status cannot obtain or renew brokered deposits without the regulators approval.

Table 10. Direction of Deposit Reallocation

Total Deposits	Core Deposits	Large Time-Deposits
Deposit Rate Advantage		
−0.0783***	−0.0493***	−0.1269***
(< 0.0001)	(< 0.0001)	(< 0.0001)
Deposit Rate Advantage / Interest Margin		
−0.0042	−0.0012	−0.0155*
(0.6278)	(0.8903)	(0.0149)
NPA		
−0.1923***	−0.1573***	−0.1351***
(< 0.0001)	(< 0.0001)	(< 0.0001)
Capital Ratio		
−0.0680***	−0.0755***	−0.0325***
(< 0.0001)	(< 0.0001)	(< 0.0001)

Note: Table 10 shows the direction of deposit reallocation across banks for a variety of measures. Net positive values indicate that on average, over the sample period, deposits are reallocated from banks in the Low group to banks in the High group, negative values indicate otherwise. We see that in addition to lower rates of deposit inflows and higher rates of deposit outflows at banks which have a high deposit rate advantage, deposits are reallocated from the high group to the low group. Similarly, we see that deposits are reallocated from banks with high levels of NPA to those with lower levels. For capital levels, while we saw banks in the high group had higher levels of deposit inflow and outflow rates, on average deposits are reallocated from the high group to the low group. These results are consistent across deposit types. These findings suggest that on average, depositors move from banks that provide them low utility to banks which give the depositors higher utility.

1.5 Conclusion

This paper examines the flow of deposits in the banking system by computing measures of deposit inflows, outflows, and the reallocation of deposits. I find that deposit inflows are larger in magnitude and volatile than deposit outflows. At any given time period there are simultaneous inflows and outflows of deposits, even in time periods of new deposit outflows. Across deposit types, the magnitude of inflows for core deposits is larger than large time-deposits, but both have similar magnitudes of deposit outflows. Moreover, the inflows and outflows of core and large time-deposits are affected differently by business and economic conditions. The findings suggest that better understand banking system stability, one needs to consider both deposit inflows and outflows and the heterogeneity in flows across deposit types.

I also find that there is substantial reallocation of deposits across banks. I find that large banks are able to attract and retain more deposits compared to their smaller counterparts. In addition to attracting and retaining more deposits, large banks have been attracting deposits away from smaller banks, and this effect is more evident after Riegle-Neal and Gramm Leach Bliley Acts. The findings suggest that deposit funding stability could be an issue of grater concern for smaller banks compared to the large banks.

Lastly, I examine the flow of deposits based on the utility depositors generate from the banks. I find that deposits largely flow to banks that provide better utility to depositors, in terms of deposit rates offered, solvency risk of the bank, and banking efficiency. These findings attest to the market disciplining role of depositors.

2 Accounting Information and Deposit Rates

2.1 Introduction

Accounting information in financial reports is intended to reduce the information asymmetry between banks' users and suppliers of funds. Prior literature has largely studied this reduction in information asymmetry through bank accounting information and its effect on equity markets, debt markets, and regulators. However, literature on the role of financial reporting in reducing information asymmetry between a banks' borrowers and depositors seems to be lacking (Beatty and Liao, 2014). This paper attempts to fill that gap in the literature by examining the relation between the largest accrual reported on banks' financial statements, i.e. Loan Loss Provisions (LLPs) and deposit rates on uninsured deposits. I focus exclusively on rates on uninsured deposits as these are the most sensitive to bank risk since these deposits would be lost in case of bank failure.[10]

My main findings are as follows: (i) Higher provisions lead to higher deposits rates, and this effect is more pronounced in banks which have a publicly listed Bank Holding Company (BHC), and after the financial crisis. (ii) This effect is more pronounced for the non-discretionary component of LLPs which reflects the losses expected on the loan portfolio, compared to the discretionary component which reflects managements' private information and could be used as a signaling tool by the management. (iii) Timeliness of provisioning leads to lower deposit rates, and this effect is evident after the financial crisis irrespective of whether the banks' BHC is publicly listed or not. (iv) Non-discretionary provisions at banks with higher loan growth, higher earnings, and conservatism in Allowance for Lease and Loan Losses (ALLL) accounting leads to higher deposit rates, while conservatism in Loan Charge-Offs (CO) accounting leads to lower deposit rates. (v) Non-discretionary provisioning at banks with higher loan concentrations reduces deposit rates, while provisioning at banks' with higher Commercial Real Estate (CRE), Commercial & Industrial Loans, and Consumer Loans leads to higher rates. And lastly, (vi) non-discretionary provisions that contribute to economic capital (in excess of Tier 2

[10]Uninsured deposits are defined as time deposits $\geq$ \$100,000 prior to Q1,2010 and time deposits $\geq$ \$250,000 since.

regulatory capital) leads to lower deposit rates, while discretionary provisions in excess of regulatory capital lead to higher deposit rates.

Before beginning an analysis of my findings, we must understand that for banks transparency via financial reporting is a double-edged sword. On the one hand transparency is vital in ensuring that depositors respond to fundamental based runs as against information based runs which are inefficient (Calomiris and Kahn, 1991b). Transparency can also increase market discipline as depositors can penalize banks for taking excessive risk by either withdrawing deposits or demanding higher deposit rates (Martinez Peria and Schmukler (2001); Park and Peristiani (1998) and Cook and Spellman (1994)). It can also enable banks to raise funds during periods of monetary tightening (Holod and Peek, 2007). On the other hand Dang et al. (2017) argue that banks are optimally opaque, and Dang et al. (2017) and Holmstrom (2008) argue that increasing transparency may affect the value of money created by banks. Opaqueness could also lead to inefficient economic outcomes such as purely information based bank runs (Morris and Shin, 2002) and (Chen and Hasan, 2006).

To understand the role financial reporting plays in determining deposit rates I start with the basic premise that rates are primarily determined by the supply of and the demand for deposits. Theoretical models such as Allen et al. (2015) suggest that the supply of deposits in based deposit rates offered by banks vis-a-vis returns offered to depositors by alternate storage technologies. To encourage investors to deposit their money at banks, deposit rates should incorporate a premium over the alternate storage technology. As banks can default endogenously (Egan, Hortaçsu, et al., 2017), leading to a loss of deposits, the deposit rate premium should incorporate bank specific distress risk. This risk premium is determined by the quantity and quality of information made available to depositors via financial reports and other means, which depositors use to assess the riskiness of the bank.

Even within financial reporting, reported accounting figures can be viewed via two different lenses. One is the direct impact of the accounting number which reveals the true underlying economic situation of the bank, subject to applicable accounting principles. Elliott et al. (1991) find that the equity markets react negatively to increases in charge-offs since it directly affects the level of loan loss reserves. On the other hand accounting number could also signal managements' private information, and the interpretation of this signal is conditional on the decision at hand (Dechow et al., 2010). Beaver and Engel (1996) and Elliott et al. (1991) find that markets react positively to increases in LLPs as this signals that banks have enough earning power to withstand some losses on their loan portfolios.

Moreover, deposit rates are an input to a banks' deposit productivity function (Egan, Lewellen, et al., 2017) which eventually translates into loan creation and thus overall value for the bank. If these deposit rates are affected by financial reporting and the interpretation of the accounting information it gives us a channel to understand how financial reporting creates value for a bank.

Firstly, we see that higher provisioning led to lower deposit rates on 12-month and higher rates on 60-month uninsured certificates of deposits (CD's), and this effect was only evident for banks with a publicly listed BHC prior to the crisis. During and post-crisis we see that increases in LLP's lead to increases in deposit rates for both 12-month and 60-month CDs irrespective of whether the banks' BHC is publicly listed or not. Moreover, timeliness in provisioning led to lower deposit rates prior to the crisis, but only for 60-month CD's for publicly listed banks. However, post-crisis this effect is observable across both product types and irrespective of the listing nature of the BHC. My findings suggest that either post-crisis the incremental information obtained on publicly listed banks from sources other than regulatory reports has lost its effect, or depositors are able to generate the same information from regulatory reports.

We also see that while non-discretionary provisions lead to higher deposit rates, discretionary provisions are largely not priced by depositors. This suggests that unlike equity providers, depositors value the direct impact of provisions, via reduction in the amount of interest generating assets, compared to banks' signal on the future profitability of the bank, which is priced by equity holders. This is consistent with the maturity risk of each security type, as depositors are more concerned about immediate interest payment rather than the long term value creation.

We have seen that non-discretionary provisions are priced by depositors but not discretionary provisions suggesting that depositors value the direct impact of accounting figures and not so much about the signal indicated by them. I next examine the effect of bank performance metrics and accounting conservatism measures on deposit rates. We see that higher loan growth accompanied by higher levels of non-discretionary provisions leads to increases in deposit rates, and this effect is most evident during and after the financial crisis. These findings suggest that investors perceive the high loan growth to be an indication of poorer loan quality and would be expected to go bad in the future. Higher non-discretionary provisions accompanied by higher earnings also leads to higher deposit rates. This could suggest that depositors perceive the higher earnings to be a result of riskier loans made in the past, which are now beginning to go bad.

In addition to bank performance measures, I look at how the effect of non-discretionary provisions and conservatism in ALLL and CO affects deposit rates. I find that banks that are conservative in their ALLL i.e have a higher than median ratio of ALLL as percentage of Non-Performing Assets (NPA's) have higher deposit rates, while banks that are more conservative in their CO's have lower deposit rates. These findings are contrary to the findings seen for equity holders where higher provisions lead to higher returns while higher CO's lead to lower returns. These findings suggest that banks that are holding higher loan loss reserves are penalized by depositors, while banks which are more willing to write-off non-performing loans tend to pay a lower deposit rate.

We have seen that higher loan growth accompanied by higher non-discretionary provisions is viewed unfavorably by depositors and leads to higher deposit rates. I next examine the combined effect of non-discretionary provisions and loan portfolio characteristics on deposit rates. We see that higher loan concentrations accompanied by higher non-discretionary provisions leads to lower deposit rates. High loan concentrations could suggest either riskiness in the loan portfolio or the banks' expertise in lending to a particular sector. Whether it is riskiness or industry expertise depositors view higher non-discretionary provisions as banks' acknowledgment in identifying troubled loans thus leading to lower deposit rates. High loan growth across loan categories accompanies by higher non-discretionary provisions is viewed negatively and leads to higher deposit rates. This effect is largely consistent post financial crisis, albeit prior to the financial crisis prior and during the crisis we see lower deposit rates on 60-month CD's experiencing high Commercial Real Estate (CRE) loan growth. Thus far my findings have suggested that depositors value the direct impact of accounting information in pricing deposits, however we see that the lower deposit rates on banks with high loan concentration could suggest that depositors also value the signaling aspect of financial reporting to some extent.

Lastly I look at the effect of provisions, both non-discretionary and discretionary, when they add to economic capital (Loan loss allowance in excess of Tier 2 regulatory capital). While additions to Tier 2 regulatory capital (and consequently to the Total Risk Based Capital Ratio) can allow a bank to increase its lending activities, increases to the economic capital increases the solvency risk for the bank. In case of loan default and charge-offs, economic capital acts as a buffer before Tier 2 and Tier 1 capital get eroded. We see that when non-discretionary provisions add to economic capital deposit rates are lower, while when discretionary provisions add to economic capital, deposit rates are higher. These findings further suggest that depositors are more concerned about the direct impact of accounting numbers reported in financial statements than the signal they provide.

In this study I have examined the changes in the deposit rates of uninsured deposits and how financial reporting and accounting information affect them. We have seen that largely depositors price the direct impact of accounting figures into deposit rates, while the private information signaled in the accounting numbers is not as valuable to depositors. This study shows that transparency in financial reporting is accompanied by market discipline reflected in the changes in deposit rates.

2.2 Background, Related Literature, and Hypotheses

As financial intermediaries, banks transform demandable deposits into illiquid loans, and in the process acquire proprietary information on the borrower. While this proprietary information reduces the information asymmetry between the borrower and the bank, the principal-agent problem between depositors and the bank remains. Calomiris and Kahn (1991a) suggest that the nature of demandable deposits should ensure bank managers' actions are incentive compatible, however the presence of deposit insurance can induce moral hazard and exacerbate the agency problem.

Even if the demandable nature of deposits could address this agency problem, not all deposits are alike. Some deposits are relationship based, and seek the banks' liquidity, payment, and transaction services, while others are more like capital providers, and seek returns on their investment. Broadly, deposits can be classified as "Core Deposits" and "Non-Core Deposits". As per Uniform Bank Performance Report (UBPR) definitions[11], Core Deposits are the sum of Demand Deposits, Transaction Accounts, Money Market Deposit Accounts (MMDA's), Savings Accounts and all Small Time Deposits, while Non-Core Deposits include all Large Time Deposits.[12]

Core deposits are primarily from customers who utilize the banks' services (such as the ability to write checks), and are likely to have a long-term and/or multiple relationships with the bank, either via deposit accounts, loans, credit cards, or otherwise. Given the nature of their relationship, and the costs involved in switching banks, these depositors are less likely leave the bank and, and are hence considered to be "stable" sources of funding. Martin et al. (2018) find that even a failing bank, core depositors were less likely to leave the bank, compared to uninsured depositors. With the implementation of Basel III, beginning 2018, banks are required to maintain minimum levels of Net Stable

[11] https://www.ffiec.gov/ubpr.htm

[12] Prior to December 2008, Large Time Deposits were defined as those greater than $100K, post December 2008, they are defined as accounts greater than $250K.

Funding Ratio (NSFR), make core deposits even more valuable.

Large time deposits on the other hand are "return seeking", and have little-to-no relationship with the bank per se. These deposits are likely to be obtained via deposit brokers, and internet listing services among other sources, and the investors in these products are primarily sophisticated individuals or corporations. In addition, these large time deposits are partially uninsured[13], and given the time nature of these deposits, the long term health of the bank is an important factor for these depositors.

Given these differences in the nature of deposits, the deposit rates for these two categories also have different properties. The stickiness or inflexibility in rate movements in response to changing environments is higher for core deposits than it is for certificates of deposits (CD's) (Driscoll and Judson, 2013), and depositor discipline to changes in bank risk is higher for large deposits (Park and Peristiani, 1998). Additionally (Iyer, Puri, and Ryan, 2016) find that depositors that have multiple relationships with the bank, or have older accounts are less likely to run in the event of a low-solvency-risk-shock to the bank, and (Martinez Peria and Schmukler, 2001) shows that deposit insurance does not diminish the effect of market discipline.

So if large time deposits are "return seeking", have no relationship with the bank, and are likely to leave the bank in case of increased risk, the deposit rates for these products should be associated with the riskiness of the bank, as ascertained from the accounting information in the banks' financial reports. For this study, I use loan loss provisions (LLPs) as a "catch-all" measure for banks' asset quality, with higher LLPs reflecting poorer asset quality, and study the impact of LLPs on deposit rates. I use LLPs as a "catch-all" measure as prior accounting literature has shown that LLPs themselves are determined by banks' profitability levels, capital levels, macro economic conditions, and prior losses on the loan portfolio. A summary of these models is given in (Beatty and Liao, 2014). Moreover, Bushman (2014) suggests that managerial accounting decisions as reflected in

[13]Deposits were insured up to $100K till December 2008, subsequently the deposit insurance limit was increased to $250K

the accounting numbers can be classified into two broad categories. The first reflecting the is a non-discretionary component which reflects the underlying aconomic behavior, the second being the discretionary component which is used to signal managements' private information. Therefore, I study the differential effect of non-discretionary (which reflect only asset quality), and discretionary (which may reflect managerial opportunism and signaling) provisions on deposit rates. I state my first hypotheses as:

Hypothesis H1a: High loan loss provisions lead to increases in deposit rates for large certificates of deposits (CD's).

Hypothesis H1b: Higher non-discretionary provisions lead to increases in deposit rates for large certificates of deposits (CD's), while the effect is not as prominent for discretionary provisions.

Financial reporting is intended to reduce information asymmetry between capital providers and managers by transforming unobservable firm performance into easily interpretable numbers. The response of capital providers to accounting information is conditional on the informativeness of this data, which is a function of the quantity and quality of data. Similarly, for loan loss provisions to be informative to deposit holders in assessing the asset quality and consequently bank specific risk, any incremental information would be informative. One such incremental piece of information is the timeliness of provisioning. Loan loss recognition is conditional on managements' subjective assessment on the probability of loan default, subject to relevant accounting principles. Thus, managers can delay recognition of loan losses if it is beneficial to them, possibly in managing earnings or capital, or otherwise. But delaying loss recognition can cause an overhang problem for the bank and may even affect its future lending behavior (Beatty and Liao, 2011), and can increase a banks' risk profile (Bushman and Williams, 2015). Timeliness in provisioning on the other hand can reduce this potential overhang and be beneficial to banks' health especially during cyclical downturns (Laeven and Majnoni, 2003). Therefore one would expect depositors to price the timeliness of provisioning in addition to the amount of provisions made.

Additionally, while all banks , private or public, have to submit financial information on their operations to their respective supervisory agencies each quarter, banks which have a publicly listed Bank Holding Company (BHC), in addition to filing quarterly reports with the supervisory agency, have to file additional reports with the Securities and Exchange Commission (SEC). (Holod and Peek, 2007) show that publicly traded banks have a lower level information asymmetry compared to private banks. Along similar lines Nichols et al. (2009) find that publicly listed firms are more conservative in their accounting practices. This additional reduction in information asymmetry, and accounting conservatism should be priced in deposit rates. I state my second hypothesis as:

Hypothesis H2: Timeliness in provisioning is viewed favorably and leads to lower deposit rates, and being part of a publicly listed BHC strengthens these results.

While accounting information reduces the information asymmetry between the two contracting parties, namely capital providers and managers, the response by capital providers to particular set of information is conditional on the decision-relevance framework (Dechow et al., 2010). For example, a higher non-interest expense would be viewed differently for a bank that is expanding and opening new branches, than for a bank that is not. Similarly, a banks' loan growth rate, earnings, accounting conservatism, and loan portfolio characteristics would be priced by a banks' depositors conditional on the performance measure of the banks' peers.

A bank growing faster than its peers could be achieving this growth on the basis of lowered credit underwriting standards (Clair, 1992), eventually resulting in increased loan losses (Foos et al., 2010). Additionally, higher earnings achieved on the basis of high loan growth, and followed by increases in provisions could be an indication of poor asset quality. On the other hand a highly concentrated loan portfolio could reflect managements' skill in a particular industry and hence viewed favorably by depositors (Berger and Sedunov, 2017), or it could indicate risky loan portfolios (Berger and Bouwman, 2013). Managers' accounting conservatism could also be priced by investors. Kothari et al. (2009) find that managers tend to delay bad news up to a certain point, while they release good news immediately, which is priced in equity returns. Even within accounting measures, conservatism could be viewed differently across measures. Beaver and Engel (1996) find that conservatism in accounting for loan loss reserves, i.e. recognition of loan losses is viewed favorably by equity as investors as they perceive this recognition as bank managements' ability to identify and deal with troubled loans in a timely manner. Griffin and Wallach (1991) find a similar reaction for banks in Latin America. Elliott et al. (1991) on the other hand find a negative reaction by equity investors to recognition of loan charge-offs as this directly reduces the loan loss reserve buffer for the banks. I state my third hypothesis as:

Hypothesis H3: Higher non-discretionary provisions accompanied with high loan growth, high earnings, and conservatism in loan loss reserves lead to higher deposit rates, while loan concentration and conservatism in charge-offs leads to lower deposit rates.

Finally, being a regulated industry, all banks have to maintain minimum capital levels to be considered "Well Capitalized", failing which, as per Section 29 of the FDIC Act[14], the bank may face restrictions on accepting certain kinds of deposits or even restrictions on deposit rates offered. Loan loss reserves currently contribute to Tier 2 capital and thus total regulatory capital. While these loan loss reserves are expected to increase the safety buffer available to the bank, it could end up increasing the risk a bank takes. Ng and Roychowdhury (2014) find that during the financial crisis, these extra buffers actually enabled banks to take on higher risks, by contributing to regulatory capital which eventually contributed to their failure. While maintaining minimum amounts of regulatory capital is paramount, banks also maintain reserves in excess of regulatory capital that adds to the overall economic capital available to the bank to absorb losses on the loan portfolio. So a bank that might otherwise appear to be risky, may be perceived differently by its capital providers if it is maintaining sufficient reserves, in excess of those classified as regulatory capital to absorb the expected losses. I state my last hypothesis

[14]https://www.fdic.gov/regulations/laws/rules/1000-3000.html

as:

Hypothesis H4: Loan loss provisions when adding to economic capital (in excess of Tier 2 regulatory capital) lowers deposit rates.

2.3 Research Design

Base Model of Deposit Rates

To examine whether bank specific risk, as inferred from accounting information in financial reports is priced in deposit rates for large CD's, I start with a base model of deposit rates:

$Deposit\ Rate_{i,t} = Base\ Rate_t + Bank\ Specific\ Risk\ Premium_{i,t}$

Where $Deposit\ Rate_{i,t}$ is the deposit rate for bank i at time t. Without loss of generality, the model for deposit rates for bank i, product j and time t can be written as:

$$r_{ijt} = \alpha_i + \theta_t + \sum_{i=1}^{p} \beta_i X_{it} + \eta_{ijt} \tag{1}$$

Where r_{ijt} is the deposit rate for bank i, product j at time t, α_i are bank fixed effects, θ_t are time fixed effects that equally affect the rate on product j at time t across all banks, and X_{it} are the risk premium (risk factors inferred from financial reports) for bank i at time t. For my study, I use the deposit rates on partially insured 12-month and 60-month CD's as r_{ijt}.

Bank Specific Risk Factors

To study whether bank specific risk is priced in deposit rates, I use a parsimonious model and focus specifically on two items, namely the Loan Loss Provisions (LLPs), which reflect the credit risk in the loan portfolio, and the Allowance for Lease and Loan Losses (ALLL) reserve, which reflects the safety buffer a bank has against expected losses. Each of these is discussed in detail in the following sections.

Loan Loss Provisions

Loan Loss Provisions (henceforth LLPs) are the single largest accrual available to bank managers, and incorporate the managers' private information on the quality of loans. For the 2005-2012 period, LLPs accounted for nearly 56% of total accruals (Beatty and Liao, 2014) at banks. LLPs reflect managements' assessment of losses expected in the loan portfolio, albeit the timing and amount of these losses only have to "reasonably" certain at the time of provisioning. The provisioning regime for my sample period, also known as the "incurred loss" approach, is guided by FAS 114 - Accounting by Creditors for Impairment of a Loan (FASB, 1993). It states that for a banks' managers to record a provision for an impaired loan the loss must be "probable", "estimable" to a certain degree, and the "credit event" should have occurred. Since provisioning requires managerial judgment in determining the "probability" of loss, occurrence of a "loss event" and the uncertain amount of losses that would be expected, managers can exercise discretion on the amount of provisions may, which may or may not accurately reflect the credit risk in the loan portfolio. I separate the managerial accounting decisions into two components in line with Bushman (2014), namely the accounting number which has a direct impact on a firms' operations and the signaling effect of the accounting number. In essence, I assume that LLPs consist of two distinct components, namely a non-discretionary (direct impact), and a discretionary component (signaling).

I examine the differential impact of total LLPs, and the various components of LLPs on deposit rates. I separate LLPs into a non-discretionary component ($\widehat{LLP}$) which reflects the credit risk in the loan portfolio, and a discretionary ($\widetilde{LLP}$) component that signals managements' private information. To compute the non-discretionary and discretionary components of LLPs, I estimate models for LLPs based on prior literature. The fitted values from the model represent the non-discretionary component ($\widehat{LLP}$), while the residuals from the model are the discretionary components ($\widetilde{LLP}$) of LLPs.

Unlike discretionary accrual models for non-financial firms which have some degree of consensus (Beatty and Liao, 2014), provision models for banks seem to capture varying features of managerial decisions depending on the period under study, economic environment, and the econometric approach used (Balboa et al., 2013). In addition to revealing managements' private information on loan quality, prior studies show that loan loss provisions are also used to smooth earnings and manage capital. Studies relating LLPs and capital management in the pre-BASEL regime,[15] such as Beatty, Chamberlain, et al. (1995); Collins et al. (1995); and Moyer (1990) find a negative relationship between LLPs and regulatory capital levels, indicating that banks with low levels of regulatory capital, could increase capital by increasing LLP's. In the post-BASEL regime, Ahmed, Takeda, et al. (1999) use the Federal Deposit Insurance Corporation Improvement Act (FDICIA) of 1991 to study capital and earnings management via loan loss provisions. The FDICIA separated total regulatory capital into Tier 1 and Tier 2 capital, with minimum risk-based capital ratios to be maintained at all times.[16] They find that while managers actively use LLPs to manage regulatory capital ratios, that is banks with lower regulatory capital use LLPs to improve their capital ratios, they however, do not find any evidence of earnings management.

In comparison, (Ma (1988); Collins et al. (1995); Bhat (1996)) find support for earnings management via LLPs. Kanagaretnam, Lobo, et al. (2004) jointly test for signaling private information and earnings management via LLPs in different capital/valuation environments and find evidence that banks that have low or high current performance compared to peers, and where the managers are optimistic about future performance have incentives to engage on both income smoothing and signaling private information via LLPs.

My model to assess managements' ex-ante ability to estimate future losses on the loan portfolio incorporates explanatory variables from a variety of existing models. I include current values of charge-offs (Beaver and Engel (1996); Beck and Narayanamoor-

[15]Prior to 1990, the full amount of Allowance for Lease and Loan Losses (ALLL) was included as part of regulatory capital.

[16]To be classified as "Well Capitalized", banks must maintain minimum Tier 1 Risk Based Capital Ratio of 8%, Total Risk Based Capital Ratio of 10%, and Tier 1 Leverage Ratio of 5%. In addition, Tier 2 capital cannot exceed Tier 1 capital

thy (2013)) as high charge-offs in one period will deplete the ALLL reserve which will need to be replenished via LLPs. I include current and lagged values of changes in loans outstanding (Beaver and Engel (1996); Kim and Kross (1998); Kanagaretnam, Krishnan, et al. (2010)), as extending greater amounts of credit increases the possibility of higher losses in the future. Including current and lagged values; of changes in non-performing loans (Bushman and Williams, 2012) accounts for the possibility that banks may rely on past information on non-performing loans to estimate loan losses in the future. I also include lagged values of ALLL (Kanagaretnam, Krishnan, et al. (2010); Beck and Narayanamoorthy (2013); Wahlen (1994); Collins et al. (1995); Beatty, Chamberlain, et al. (1995)) to control for the total amount of reserve banks hold against losses, high reserve levels in the past may warrant lower levels of provisions going forward.

I also include macroeconomic variables such as changes in unemployment rate and return on the case shiller home price index (Beck and Narayanamoorthy, 2013), and GDP growth rate (Bushman and Williams, 2012). I also include lagged values of Tier 1 risk based capital ratio (Tier 1 RBCR) (Balboa et al., 2013), and current values of earnings before provisions and taxes (EBTP) (Kanagaretnam, Krishnan, et al. (2010); Ahmed, Takeda, et al. (1999)). In addition to reported accounting data and macro economic variables, I also include a dummy variable for the federal regulator of the bank since the levels of scrutiny in loan loss provisions varies among regulators (Nicoletti, 2016). For national banks, the federal regulator is the OCC, for state member banks it is the Federal Reserve and for state non-member banks, it is the FDIC. I control for bank fixed effects in all the models.

I estimate the following model, and use fitted values from the model as the non-discretionary component ($\widehat{LLP}$) and residuals (ϵ_{it}) as the discretionary component ($\widetilde{LLP}$).

$$\begin{aligned} LLP_{it} = \alpha_i &+ \beta_1 CO_{it} + \beta_2 \Delta Loan_{it} + \beta_3 \Delta Loan_{it-1} + \beta_4 \Delta NPA_{it+1} + \beta_5 \Delta NPA_{it} \\ &+ \beta_6 \Delta NPA_{it-1} + \beta_7 \Delta NPA_{it-2} + \beta_7 Size_{it-1} + \beta_8 ALW_{it-1} + \beta_9 Regulator_{it} \\ &+ \beta_{10} CSHI\_Ret_t + \beta_{11} Unemp\_Change_t + \beta_{12} GDP\_Growth_t + \epsilon_{it} \end{aligned} \tag{2}$$

LLP is the loan loss provisions scaled by lagged loans, CO is the net charge-off's scaled by lagged loans , $\Delta Loan$ is the changes in loans scaled by total assets, ΔNPA is the changes in non-performing loans scaled by lagged loans, ALW is the allowance for lease and loan loss scaled by total loans, $Regulator$ is the primary federal regulator[17], $Size$ is the log of total assets, $CSHI\_Ret$ is the return on the Case-Shiller Index, $Unemp\_Change$ is the change in the unemployment rate, and GDP_Growth is the GDP growth rate.

I then use the total, non-discretionary LLPs ($\widehat{LLP}$), and discretionary LLP's ($\widetilde{LLP}$) separately to estimate their effect on deposit rates under various financial reporting environments. The model I estimate is:

$$r_{ijt} = \alpha_i + \gamma\theta_t + \beta LLP_{i,t-1} * Z_{i,t-1} + \eta_{it} \tag{3}$$

Where r_{ijt} is the deposit rate for bank i, product j, at time t; α_i are bank fixed effects, θ_t is the federal funds rate for time period t, and $Z_{i,t-1}$ is the timeliness in reporting provisions. The models are estimated separately for banks that have a publicly listed Bank Holding Company (BHC) and banks that don't. The incremental information on bank health from its financial reporting environment is discussed next.

Financial Reporting Environment

In addition to the information on loan loss provisions available in the quarterly financial reports, timeliness in provisioning can provide depositors additional information on the health of the bank. Timeliness in provisioning is computed as lower values of Delayed Expected Loss Recognition (DELR), where DELR is computed as the incremental R^2 impact of including changes in current and future non-performing loans in explaining LLPs (Nichols et al., 2009). Higher incremental R^2 indicates low DELR or high timeliness. Prior literature shows timeliness in loss recognition to be associated with banks' lending behavior (Beatty and Liao, 2011), and riskiness (Laeven and Majnoni, 2003).

[17] The primary federal regulator is the OCC for banks with National charter, The Federal Reserve for State Member banks, and FDIC for State Non-Member banks.

Additionally the model specified on equation 3 is estimated separately for banks with, and without a public BHC. As a publicly listed company, in addition to the call reports the bank files with its regulator, the parent company is also required to file quarterly reports with the Securities and Exchange Commission (SEC). As these reports filed with the SEC are much more detailed than call reports, it would add to the information available to depositors of these banks, compared to those that do not file with the SEC. (Holod and Peek, 2007) show a reduction in the information asymmetry for publicly listed firms compared to private firms.

Non-Discretionary Provisions

I further study only the effect of non-discretionary LLPs ($\widehat{LLP}$) under various performance, accounting conservatism, and loan portfolio characteristics. All performance/accounting conservatism, and loan portfolio characteristics are explained in subsequent sections. The model I estimate is:

$$r_{ijt} = \alpha_i + \gamma\theta_t + \beta\widehat{LLP}_{i,t-1} * Z_{i,t-1} + \eta_{it} \quad (4)$$

Where r_{ijt} is the deposit rate for bank i, product j, at time t; α_i are bank fixed effects, θ_t is the federal funds rate for the time period t, $\widehat{LLP}$ are the non-discretionary provisions, and $Z_{i,t-1}$ are the various performance, accounting conservatism, and loan portfolio characteristics. These characteristics are described below.

Detailed definitions of the variables used in the regression models are given in Table A. For performance measures I use the banks' total loan growth and its Earnings before Taxes and Provisions (EBTP). Loan growth is computed over a one-year period, while EBTP is the 4-quarter moving average. Both the variables are dummies, which have a value of 1 if they are above the median value for that quarter, and 0 otherwise.

For accounting conservatism, I use two measures, namely conservatism in Allowance for Lease and Loan Losses (ALLL), and conservatism in Charge-Offs (CO). Conservatism in ALLL is Computed as the rank of the distance between 4-quarter moving average

ALLL measure for each bank and the median value during that quarter. ALLL measure is computed as the ratio of ALLL/ NPAs. ALLL conservatism is a dummy variable which takes the value of 1 if ALLL is above the median value for that quarter, and 0 otherwise. Conservatism in Charge-Offs (CO) is computed as the rank of the distance between 4-quarter moving average CO measure for each bank and the median value during that quarter. The CO measure is computed as the ratio Charge-Offs / NPAs. CO conservatism is also a dummy variable which takes the value of 1 if CO is above the median value for that quarter, and 0 otherwise

I use four measures for loan portfolio characteristics, namely loan concentration HHI, and growth rates in Commercial Real Estate (CRE), Commercial & Industrial (C&I), and Consumer loans. Loan concentration HHI is computed as the Herfindahl-Hirschman index (HHI) across five loan categories, namely CRE loans, C&I loans, Consumer loans, Agricultural loans, and Farmland loans. Loan HHI is the 4-quarter moving average, while growth rates are for a 1 year period. All measures are converted into dummy variables, which have a value of 1 if they are above the median value for that quarter, and 0 otherwise.

Economic Capital

The Allowance for Lease and Loan Losses (ALLL) reserve is a contra-asset, and loans are reported net of this adjustment on the balance sheet. LLP's and loan recoveries contribute to this reserve while charge-offs deplete this reserve. By definition:

$ALLL_t = ALLL_{t-1} + LLP_t + Recoveries_t - \text{Charge-Offs}_t$.

The ALLL reserve is an important determinant of both regulatory capital and the safety buffer a bank has. ALLL up to 1.25% of Risk Weighted Assets (RWA) is considered part of Tier 2 capital and contributes to total regulatory capital. ALLL above this limit does not contribute to regulatory capital but acts as a buffer against which realized loan losses are recognized, thereby protecting erosion of regulatory capital. I define ALLL amounts in excess to those contributing to Tier 2 Capital as "Economic Capital". Additions to Economic Capital is a dummy variable that takes value 1 when $ALLL_t \geq 1.25\%\ RWA_t$.

The decision to provision or not directly affects the total buffer (regulatory capital + economic capital) a banks has. For example, a bank has Earnings Before Taxes and Provisions (EBTP) of $100 and a tax rate (T)of 40%. If a bank makes no provisions, then $60 (EBTP*(1-T)), is added to Tier 1 capital via retained earnings and total buffer increases by $60. If however the bank makes $100 in provisions, $100 gets added to the ALLL reserve, either partly or wholly as Tier 2 capital and the remaining as economic capital, but the total buffer now increases by $100. Correspondingly, whether LLPs contribute to regulatory capital, or to the safety buffer can be informative to depositors.

To examine the effect on deposit rates when total, non-discretionary, and discretionary provisions add to economic capital, I estimate the following model:

$$r_{ijt} = \alpha_i + \gamma\theta_t + \beta LLP_{i,t-1} * Z_{i,t-1} + \eta_{it} \tag{5}$$

Where $Z_{i,t-1}$ is the Economic Capital Add dummy, as defined earlier, and LLP is total, non-discretionary ($\widehat{LLP}$), and discretionary provisions ($\widetilde{LLP}$).

2.4 Data and Descriptive Statistics

This study employs deposit rate data from RateWatch, bank fundamentals from the Reports of Condition and Income ("Call Reports"), and the Federal Funds Rate from the Federal Reserve Economic Data (FRED), maintained by the Federal Reserve Bank of St. Louis.

RateWatch provides weekly deposit rate data at the branch level for banks, credit unions, savings & loan organizations, among others on a multitude of of products including savings and checking accounts, money market deposit accounts (MMDA's), and certificates of deposit (CD's) for maturities ranging from 3-months to 60-months. My total sample consists of weekly deposit rate data from 75,492 branches spread across 6,658 banks from Jan, 2002 - March, 2014.

I use deposit rates of CD's for $100K accounts for the time period up to December

2008, starting January 2009 I use rates for \$250K accounts. I choose the highest denomination CD's, as large time deposits in addition to being non-core and consequently having little-to-no relationship with the bank, are largely from sophisticated investors and corporations, and would be most sensitive to changes in bank risk. All weekly deposit rates are averaged for the quarter for each bank to ensure compatibility with the Call report data, which is at the quarterly level. Average quarterly rates for 12-month and 60-month CD's, and the Fed Funds Rate from 2001 - 2014 are plotted in Figure 5 and summary statistics for deposit rates and bank fundamentals used in the analysis are given in Table 11.

While branches of failed banks that were not acquired by any other institution are not included in the sample, branches that were acquired as a result of merger are included in the dataset, and their deposit rate data is reported as always belonging to the acquiring institution. To adjust for mergers, I obtain the history of branch ownership change from RateWatch and match each branch to their owner prior to the merger. This branch change history is only available starting 2007. To adjust for mergers prior to that I simply leave out the acquiring bank that was involved in a merger.

I obtain bank fundamental data from the Call reports which all banks file with their respective regulatory authorities. Call reports are available in machine readable format from the Chicago Fed website[18]. I restrict my sample to commercial banks to ensure uniformity in business practices, and exclude banks with Total Assets < \$25 million. I also exclude Too Big To Fail (TBTF) banks for the 2007-2008 financial crisis period[19] . Implicit government guarantees could have affected both the deposit rates at these banks, and increased regulatory scrutiny could have affected their loan loss provisioning behavior, which could distort my results.

Deposit rate data is matched to bank fundamental data using the "RSSD ID", which is a unique identifier for each bank. Banks for which the "RSSD ID" is not available in

[18]https://www.chicagofed.org/banking/financial-institution-reports/commercial-bank-data

[19]Includes Bank of America Corp., Goldman Sachs Group, Bank of New York Mellon Corp., Chase Manhattan Corp., State Street Boston Corp., Citigroup Inc., Northwest Bancorporation

the deposit rates data are removed from the sample[20]. My final sample consists of both deposit rate and bank fundamental data for 5,378 unique banks, though not all banks offer all the products for the entire sample period.

Descriptive Statistics: Deposit Rates

Figure 5 shows the plots for the deposit rates on $100K CD's for 12 and 60 month CD's and the Federal Funds Rate for the time period 2001 - 2014 and Table 11 shows the summary statistics for the deposit rates for the given time periods. It can be seen that the deposit rates for CD's move in close alignment with the Federal Funds Rate. It can be seen that on average, across time periods, deposit rates on CD's are above the Federal Funds Rate, implying the existence of a premium over and above the base rate.

It can be seen that the average Federal Funds Rate rose from 2.76% during the 2002-2006 period to 3.04% during 2007-2008, before falling to 0.12% after the crisis. Deposit rates on $100K 12-month CD's rose from 2.85% in 2002-2006 period to 3.18% for to the 2007-2008 period. In contrast deposit rates on $100K 60-month CD's fell from an average of 3.83% in the 2002-2006 period to 3.63% during 2007-2008 period. Post-crisis, average deposit rates for $250K accounts for 12-month and 60-month CD's were 0.59% and 1.36% respectively, well above the average fed funds rate of 0.12%.

[20]Banks for which the RSSD ID is not available, also have missing values for CERT ID, which is a unique ID provided by the FDIC, hence matching on CERT is also not possible

Figure 5. CD Rates and Fed Funds Rates

Note: Figure 5 shows the average quarterly deposit rates on $100K CD accounts for 12 and 60 month CD's, and the average quarterly federal funds rate. We see that on average prior to and after the crisis the federal funds rate was lower than the rate offered on 12-month and 60-month Certificates of Deposit Accounts. During the crisis we see the federal funds rate was higher. The average federal funds rate is lower in the summary statistics during the crisis period as the drop in the rate was sharper than the drop in 12-month and 60-month CD rates.Broadly, we see that deposit rates and the federal funds rate seem to be highly correlated to one another.

Descriptive Statistics: Bank Fundamentals

Table 11 shows the summary statistics for Loan loss provisions, Allowance for Lease and Loan Losses (ALLL), and Charge-Offs (CO), in addition to various dummy variables used in the study. It can be seen that ALLL and CO have been on a consistent decline during the period. ALLL declined from 4.61x NPA prior to the crisis, to 2.68x during the crisis, eventually to 1.34x post-crisis. Similarly CO declined from 9.7% of NPA to

Table 11. Summary Statistics - Deposit Rates and Bank Fundamentals

Variables	N	Mean	St. Dev.	Min	Max
	Q1,2002 - Q4,2006				
Avg. Quarterly Fed Funds Rate	12,836	2.761	1.599	0.980	5.250
Avg. Quarterly Deposit Rate (12M CD)	12,836	2.846	1.208	0.322	5.133
Avg. Quarterly Deposit Rate (60M CD)	3,029	3.830	0.729	1.570	5.133
ACLA	12,769	0.010	0.013	0.000	0.188
LLP	12,769	0.001	0.001	0.000	0.005
CO	11,665	0.097	0.165	−0.125	0.974
Log (Total Assets)	12,836	12.206	1.118	10.133	17.773
ALLL	11,665	4.617	7.215	0.381	41.353
EBTP	12,769	0.007	0.052	−5.762	0.370
	Dummy Variables				
Econ. Capital Add	12,836	0.350	0.477	0	1
Public BHC	12,836	0.112	0.316	0	1
Size > $10*bn*	12,836	0.007	0.083	0	1
	Q1,2007 - Q4,2008				
Avg. Quarterly Fed Funds Rate	8,397	3.047	1.780	0.160	5.260
Avg. Quarterly Deposit Rate (12M CD)	8,397	3.182	1.004	0.262	5.070
Avg. Quarterly Deposit Rate (60M CD)	1,880	3.633	0.781	1.077	5.070
ACLA	8,365	0.018	0.024	0.000	0.329
LLP	8,365	0.001	0.002	0.000	0.015
CO	7,686	0.071	0.116	−0.081	0.614
Log (Total Assets)	8,397	12.363	1.105	10.150	18.703
ALLL	7,686	2.685	4.494	0.200	27.240
EBTP	8,365	0.003	0.167	−15.222	0.167
	Dummy Variables				
Econ. Capital Add	8,397	0.312	0.463	0	1
Public BHC	8,397	0.107	0.309	0	1
Size > $10*bn*	8,397	0.007	0.084	0	1
	Q1,2009 - Q1,2014				
Avg. Quarterly Fed Funds Rate	57,956	0.118	0.036	0.070	0.210
Avg. Quarterly Deposit Rate (12M CD)	57,956	0.559	0.268	0.050	2.500
Avg. Quarterly Deposit Rate (60M CD)	44,526	1.365	0.388	0.050	2.855
ACLA	57,911	0.040	0.054	0.000	0.902
LLP	57,911	0.001	0.002	−0.001	0.021
CO	55,984	0.042	0.071	−0.039	0.375
Log (Total Assets)	57,956	12.048	1.013	10.127	18.547
ALLL	55,984	1.340	1.775	0.152	9.875
EBTP	57,911	0.005	0.008	−0.638	0.410
	Dummy Variables				
Econ. Capital Add	57,956	0.659	0.474	0	1
Public BHC	57,956	0.048	0.213	0	1
Size > $10*bn*	57,956	0.007	0.059	0	1

Note: Table 11 shows the summary statistics for the variables used in the main model for deposit rates. Data on deposit rates was obtained from RateWatch, Fed Funds Rate was obtained from Federal Reserve Bank of St. Louis website, and all fundamental bank variables were obtained from the Reports of Condition and Income ("Call Reports"). Deposit rates for CD's are for $100K accounts till Q4,2008 and for $250K accounts thereafter. All variables have been winsorized at the 5^{th} and 95^{th} percentile.

7% during the crisis, and eventually to 4.2% of NPA post-crisis. This consistent decline in ALLL and CO ratios can be explained in part by a monotonic increase in the total amount of Non-Performing Assets (ACLA in the summary table) as percentage of loans. Non-Performing Assets (NPA's) as percentage of Total Loans increased from 1% prior to the crisis, to 1.8% during the crisis, and 4% post crisis. The percentage of bank-quarters, where banks' ALLL was in excess of its regulatory Tier 2 capital has increased from 35% prior to the crisis to 66% post crisis.

2.5 Results

Tables 12 to 13 show the results for the various hypotheses being tested. I place a caveat here, that given the "near-zero" federal funds and deposit rates in the period beginning 2009, one must exercise caution in the interpretation of these results. Due to both the low levels and low variability in deposit rates, a low R^2 is a mechanical effect, and does not reflect on the goodness-of-fit of the models being estimated.

Loan Loss Provisions and Financial Reporting

Tables 12 and 13 show the effect of loan loss provisions, timeliness in reporting these provisions, and the effects of non-discretionary and discretionary provisions, for public and non-public BHC's, on deposit rates. We see that LLPs are positively associated with higher deposit rates. This effect is consistent during and after the crisis, for both the 12-month and 60-month CD's. Post-crisis, the average quarterly rate on 12-month CD's increases by 0.29-0.44 percentage points, and the average quarterly rate for 60-month CD's increases by 0.55-0.91 percentage points, for a 1 percentage point increase in LLPs. While LLPs by themselves are associated with higher deposit rates, higher LLPs in combination with timely reporting of these provisions is viewed favorably by depositors, leading to lower deposit rates, though the effect is more evident in the post-crisis period, and for banks with publicly listed BHC's. Post-crisis, increases in LLPs accompanied with timeliness lowers deposit rates by 0.02-0.14 percentage points for 12-month CDs, and by 0.05-0.18 percentage points for 60-month CDs. We also see that while non-discretionary provisions are consistently and positively associated with higher deposit rates, the effect of discretionary provisions is ambiguous and inconsistent. Post-crisis, a percentage point increase in non-discretionary provisions increases deposit rates by 0.61-0.71 percentage points for 12-month CDs, and by 1.18-1.41 percentage points for 60-month CDs.

These findings suggest that in addition to information garnered from accounting information in regulatory financial reports, the additional information obtained from SEC filings by publicly listed BHCs increases the sensitivity of deposit rates to bank specific information. It also suggests that depositors price the direct impact of accounting numbers on banks' fundamentals into deposit rates, while the signaling effect is not priced. This is in contrast to prior studies that found that both non-discretionary and discretionary components of LLPs are priced by equity markets (Beaver and Venkatachalam, 1999). Henceforth, in the remaining results and corresponding tables I only consider the non-discretionary component of LLPs in my analysis, except when analyzing the effect of LLPs when they add to economic capital, I consider total, non-discretionary, and discretionary LLPs.

Table 12. Loan Loss Provisions, Financial Reporting Environment, and Deposit Rates (12-Month CD's)

	Dependent variable: Average Quarterly Deposit Rate r_{ijt}								
	Public BHC								
	Q1,2002 - Q4,2006 (CD 100K)			Q1,2007 - Q4,2008 (CD 100K)			Q1,2009 - Q1,2014 (CD 250K)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
LLP	−0.365**	−0.400**		0.118**	0.106*		0.372***	0.434***	
	(0.156)	(0.174)		(0.059)	(0.062)		(0.032)	(0.045)	
*LLP*Timeliness*		0.411			0.023			−0.144***	
		(0.300)			(0.089)			(0.051)	
$\widehat{LLP}$			0.228			0.288***			0.712***
			(0.254)			(0.077)			(0.052)
$\widetilde{LLP}$			−0.706***			−0.091			0.115
			(0.200)			(0.084)			(0.280)
Observations	3,405	3,405	3,388	1,929	1,929	1,924	4,781	4,781	4,685
R^2	0.893	0.895	0.894	0.788	0.788	0.789	0.206	0.213	0.270
	Non-Public BHC								
LLP	0.022	0.030		0.249***	0.258***		0.292***	0.303***	
	(0.059)	(0.065)		(0.026)	(0.031)		(0.006)	(0.008)	
*LLP*Timeliness*		−0.032			−0.022			−0.023**	
		(0.129)			(0.043)			(0.010)	
$\widehat{LLP}$			0.233**			0.432***			0.641***
			(0.107)			(0.034)			(0.010)
$\widetilde{LLP}$			−0.070			0.056			0.007
			(0.068)			(0.037)			(0.008)
Observations	13,610	13,610	13,463	8,738	8,738	8,644	59,956	59,956	59,397
R^2	0.896	0.896	0.896	0.819	0.819	0.820	0.116	0.116	0.196
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fed. Funds Rate	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: *p<0.1; **p<0.05; ***p<0.01

Table 13. Loan Loss Provisions, Financial Reporting Environment, and Deposit Rates (60-Month CD's)

	Dependent variable: Average Quarterly Deposit Rate r_{ijt}								
	Q1,2002 - Q4,2006 (CD 100K)			Q1,2007 - Q4,2008 (CD 100K)			Q1,2009 - Q1,2014 (CD 250K)		
	Public BHC								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
LLP	0.104***	0.161		0.106*	0.059*		0.832***	0.915***	
	(0.021)	(0.219)		(0.061)	(0.033)		(0.058)	(0.077)	
*LLP*Timeliness*		−0.328***			0.099			−0.180**	
		(0.036)			(0.094)			(0.081)	
$\widehat{LLP}$			0.707*			0.120*			1.412***
			(0.390)			(0.069)			(0.081)
$\widetilde{LLP}$			−0.226			0.072			0.383***
			(0.276)			(0.115)			(0.068)
Observations	1,669	1,669	1,662	848	848	847	4,191	4,191	4,105
R^2	0.692	0.693	0.694	0.718	0.718	0.718	0.222	0.225	0.270
	Non-Public BHC								
LLP	0.130	0.154		0.257***	0.285***		0.553***	0.579***	
	(0.099)	(0.108)		(0.058)	(0.071)		(0.011)	(0.015)	
*LLP*Timeliness*		−0.113			−0.097			−0.056***	
		(0.209)			(0.091)			(0.020)	
$\widehat{LLP}$			0.215			0.419***			1.182***
			(0.176)			(0.059)			(0.018)
$\widetilde{LLP}$			0.059			0.047			0.026
			(0.105)			(0.097)			(0.017)
Observations	3,198	3,198	3,167	1,924	1,924	1,912	46,076	46,076	45,631
R^2	0.767	0.767	0.768	0.729	0.730	0.732	0.120	0.120	0.212
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fed. Funds Rate	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: *p<0.1; **p<0.05; ***p<0.01

Non-Discretionary Provisions, Operating Performance, and Accounting Conservatism

Table 14 shows the effect of non-discretionary provisions under various bank performance and accounting conservatism environments, on deposit rates. Consistent with previous results, I find that ceteris paribus, non-discretionary provisions are positively associated with higher deposit rates, and these results are consistent for both 12-month and 60-month CD's. Higher non-discretionary provisions at banks facing higher loan growth is associated with higher deposit rates. This is consistent with prior studies which have shown that high loan growth has been associated with increased riskiness in the loan portfolio (Foos et al. (2010); Jin et al. (2011)). This suggests that high loan growth could possibly have been achieved by lowered credit standards, and in due time these loans have started to go bad, resulting in increased non-discretionary provisions. To compensate for this increase in loan portfolio risk, banks have to pay an increased risk premium to depositors, resulting in increased deposit rates.

One would expect to see banks with higher past earnings to be viewed favorably by deposit holders, and we see the result as expect for the periods leading up to, and through the crisis. Higher non-discretionary provisions accompanied by higher earnings lead to lower deposit rates. Post-crisis however, this effect seems to have reversed, and higher non-discretionary provisions accompanies by higher earnings leads to higher deposit rates. A possible explanation could be that depositors perceive that the past levels of higher earnings were achieved on the basis of a risky loan portfolio, which is now beginning to show signs of deterioration, hence depositors view this adversely. Another possible explanation is given by Graham et al. (2005), who suggest that managers tend to delay bad news in the hope that subsequent events will turn in their favor. These findings suggest that depositors can infer the "bad news" in non-discretionary provisions and possibly weigh it more than the "good news" suggested by earnings.

Table 14. Non-Discretionary Provisions, Bank Performance and Accounting Conservatism, and Deposit Rates

	Dependent variable: Average Quarterly Deposit Rate r_{ijt}											
	Q1,2002 - Q4,2006 (12M CD 100K)				Q1,2007 - Q4,2008 (12M CD 100K)				Q1,2009 - Q1,2014 (12M CD 250K)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$\widehat{LLP}$	0.135	0.435**	0.125	0.552***	0.370***	0.401***	0.425***	0.621***	0.584***	0.582***	0.581***	0.871***
	(0.137)	(0.178)	(0.141)	(0.196)	(0.045)	(0.043)	(0.041)	(0.068)	(0.010)	(0.012)	(0.011)	(0.019)
$\widehat{LLP}$ * *Loan Growth*	0.071				0.047*				0.184***			
	(0.157)				(0.026)				(0.019)			
$\widehat{LLP}$ * *Earnings*		−0.439**				−0.028				0.159***		
		(0.210)				(0.065)				(0.019)		
$\widehat{LLP}$ * *ALLL Conservatism*			0.212				−0.079				0.219***	
			(0.205)				(0.067)				(0.023)	
$\widehat{LLP}$ * *CO Conservatism*				−0.455**				−0.268***				−0.295***
				(0.191)				(0.071)				(0.020)
Observations	12,622	12,622	12,622	12,622	8,268	8,268	8,268	8,268	57,318	57,318	57,318	57,318
R^2	0.898	0.898	0.898	0.898	0.812	0.812	0.813	0.813	0.197	0.194	0.196	0.209
	Q1,2002 - Q4,2006 (60M CD 100K)				Q1,2007 - Q4,2008 (60M CD 100K)				Q1,2009 - Q1,2014 (60M CD 250K)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$\widehat{LLP}$	0.597**	0.632**	0.435*	1.107***	0.316***	0.355***	0.443***	0.334**	1.059***	1.075***	1.061***	1.590***
	(0.274)	(0.277)	(0.255)	(0.339)	(0.070)	(0.069)	(0.068)	(0.138)	(0.020)	(0.021)	(0.019)	(0.036)
$\widehat{LLP}$ * *Loan Growth*	−0.348				0.062***				0.389***			
	(0.338)				(0.012)				(0.035)			
$\widehat{LLP}$ * *Earnings*		−0.325				−0.016				0.285***		
		(0.320)				(0.093)				(0.038)		
$\widehat{LLP}$ * *ALLL Conservatism*			0.020				−0.323				0.442***	
			(0.393)				(0.197)				(0.045)	
$\widehat{LLP}$ * *CO Conservatism*				−0.841**				0.001				−0.536***
				(0.357)				(0.144)				(0.037)
Observations	2,988	2,988	2,988	2,988	1,863	1,863	1,863	1,863	44,017	44,017	44,017	44,017
R^2	0.777	0.777	0.776	0.777	0.723	0.723	0.724	0.723	0.210	0.207	0.210	0.225
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fed. Funds Rate	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: *p<0.1; **p<0.05; ***p<0.01

Prior literature suggests that overall conservatism in accounting leads to lower cost of debt for firms (Ahmed, Billings, et al., 2002). To assess the effect of accounting conservatism on deposit rates, I examine the effect of non-discretionary provisions, in conjunction with banks' past conservatism in reporting of Allowance for Lease and Loan Losses (ALLL) and Charge-Offs (CO). I find that conservatism in accounting for ALLL leads to higher deposit rates, and this effect is only pronounced post-crisis. On the other hand, conservatism in accounting for CO leads to lower deposit rates, and this effect is present pre, during, and post-crisis periods. Conservatism in ALLL, that is maintaining a high level of Loan Loss Reserve as a percentage of Total Loans could possibly indicate an increased riskiness in the banks activities going forward. Loan Loss Reserve contributes to Tier 2 regulatory capital (upto 1.25% of Risk Weighted Assets), which could enable banks to increase the risk of their loan portfolio. Ng and Roychowdhury (2014) find that during the financial crisis banks used this Tier 2 capital to take on excessive risks, which eventually contributed to bank failures. Conservatism in CO, that is a having higher levels of Charge-Offs as percentage of Non-Performing Assets, could indicate banks' intentions in dealing with troubled loans in a timely manner so as not to create an overhang problem going forward.

Non-Discretionary Provisions and Loan Portfolio Characteristics

Table 15 shows the effect of non-discretionary provisions on deposit rates for various loan portfolio characteristics. We saw previously that higher levels of non-discretionary provisions in conjunction with high loan growth is perceived negatively by depositors and leads to higher deposit rates. I next examine how non-discretionary provisions in conjunction with loan portfolio characteristics such as loan concentration levels, and loan growth in individual categories affects deposit rates.

Table 15. Non-Discretionary Provisions, Loan Portfolio Characteristics, and Deposit Rates

	Dependent variable: Average Quarterly Deposit Rate r_{ijt}											
	Q1,2002 - Q4,2006 (12M CD 100K)				Q1,2007 - Q4,2008 (12M CD 100K)				Q1,2009 - Q1,2014 (12M CD 250K)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$\widehat{LLP}$	0.875**	0.156	0.004	0.182	0.736***	0.419***	0.408***	0.376***	0.981***	0.594***	0.598***	0.626***
	(0.413)	(0.139)	(0.137)	(0.127)	(0.129)	(0.042)	(0.046)	(0.042)	(0.031)	(0.011)	(0.011)	(0.011)
$\widehat{LLP} * Loan\ Concentration$	−1.460*				−0.666***				−0.647***			
	(0.867)				(0.233)				(0.054)			
$\widehat{LLP} * CRE\ Loan\ Growth$		0.062				−0.067				0.115***		
		(0.137)				(0.063)				(0.016)		
$\widehat{LLP} * C\&I\ Loan\ Growth$			0.449***				−0.028				0.110***	
			(0.143)				(0.059)				(0.016)	
$\widehat{LLP} * Cons.\ Loan\ Growth$				0.007				0.043				0.039**
				(0.172)				(0.058)				(0.016)
Observations	12,622	12,622	12,622	12,622	8,268	8,268	8,268	8,268	57,318	57,318	57,318	57,318
R^2	0.898	0.898	0.898	0.898	0.813	0.812	0.813	0.812	0.196	0.193	0.194	0.191
	Q1,2002 - Q4,2006 (60M CD 100K)				Q1,2007 - Q4,2008 (60M CD 100K)				Q1,2009 - Q1,2014 (60M CD 250K)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$\widehat{LLP}$	0.685	0.775***	0.528**	0.553**	0.690***	0.419***	0.341***	0.303***	1.696***	1.077***	1.080***	1.143***
	(0.833)	(0.232)	(0.227)	(0.218)	(0.222)	(0.070)	(0.073)	(0.065)	(0.061)	(0.021)	(0.021)	(0.021)
$\widehat{LLP} * Loan\ Concentration$	−0.485				−0.606				−0.973***			
	(1.644)				(0.370)				(0.105)			
$\widehat{LLP} * CRE\ Loan\ Growth$		−0.651**				−0.193*				0.244***		
		(0.276)				(0.111)				(0.030)		
$\widehat{LLP} * C\&I\ Loan\ Growth$			−0.185				0.021				0.243***	
			(0.269)				(0.102)				(0.029)	
$\widehat{LLP} * Cons.\ Loan\ Growth$				−0.239				0.127				0.089***
				(0.323)				(0.107)				(0.029)
Observations	2,988	2,988	2,988	2,988	1,863	1,863	1,863	1,863	44,017	44,017	44,017	44,017
R^2	0.777	0.777	0.777	0.777	0.723	0.723	0.723	0.723	0.208	0.207	0.207	0.205
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fed. Funds Rate	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Note:												*p<0.1; **p<0.05; ***p<0.01

I find that non-discretionary provisions accompanied by higher loan concentration levels leads to lower deposit rates. This could possibly suggest that higher loan concentration levels are viewed by depositors as indications of a banks' expertise in lending to certain sectors. Additionally, managements' ability and willingness to recognize losses based on their expertise is viewed positively by depositors.

For loan growth within individual categories, we see that for Commercial Real Estate (CRE) loans, in the period leading up to and into the crisis, managements ability to identify and recognize losses was viewed favorably by depositors. This effect has however reversed since, and is consistent across the 12-month and 60-month CD's. For both Commercial & Industrial (C&I) and Consumer loans, we see that higher non-discretionary provisions accompanied with high levels of loan growth lead to higher deposit rates, the results being consistent for both the 12-month and 60-month CD's, in the post-crisis period. These findings suggest that both high levels of overall loan growth and loan growth within individual categories, when accompanied by higher levels of non-discretionary provisions is perceived as increased riskiness by depositors, which leads to higher deposit rates.

Loan Loss Provisions and Additions to Economic Capital

We have seen consistent evidence that both total and non-discretionary loan loss provisions are consistently and positively associated with higher deposit rates in general. However, depending on the circumstances they can be viewed as either reflecting the riskiness in the loan portfolio leading to higher deposit rates, or the banks' ability to recognize and absorb these losses leading to lower deposit rates. Table 16 shows the effect of total, non-discretionary and discretionary components when they add to economic capital.

Loan Loss Provisions (LLPs) directly add to the Allowance for Lease and Loan Losses (ALLL) which is a contra-asset on the banks' balance sheet. In the event a loan is written off as unrecoverable, a Charge-Off of the loan is created which depletes the ALLL reserve. ALLL up to 1.25% of Risk Weighted Assets (RWA) is considered as part of a banks' Tier 2 regulatory capital. ALLL reserves in excess of Tier 2 regulatory capital is considered Economic Capital as it provides additional reserves to the bank against which loan defaults can be written off and increases the long term solvency of the bank.

We see that for both total and non-discretionary components, additions to economic capital are viewed favorably by depositors, and leads to lower deposit rates, however, the additions of discretionary provisions to economic capital has the opposite effect, and leads to higher deposit rates. A possible explanation for this could be that increases in credit risk in the loan portfolio, as reflected by total and non-discretionary LLP's, when accompanied by an increase in the total safety buffer of the bank is viewed favorably by depositors, but increases in discretionary provisions is viewed as opportunistic behavior by the management, and hence subsequently penalized.

These findings suggest that depositors, especially the partially uninsured ones, do price a banks' insolvency risk, as they would lose their deposits in case of a bank failure. Changes in deposit rates reflects a disciplining mechanism employed by depositors.

Table 16. Loan Loss Provisions, Additions to Economic Capital, and Deposit Rates

	Dependent variable: Average Quarterly Deposit Rate r_{ijt}								
	Q1,2002 - Q4,2006 (12M CD 100K)			Q1,2007 - Q4,2008 (12M CD 100K)			Q1,2009 - Q1,2014 (12M CD 250K)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
LLP	−0.041			0.146***			0.363***		
	(0.075)			(0.056)			(0.017)		
$\widehat{LLP}$		0.241			0.343***			0.930***	
		(0.151)			(0.061)			(0.025)	
$\widetilde{LLP}$			−0.192**			−0.112			−0.414***
			(0.088)			(0.072)			(0.034)
Econ. Capital Add	−0.037	−0.009	−0.031	0.045*	0.075***	0.101***	0.023***	0.097***	0.036***
	(0.026)	(0.030)	(0.022)	(0.027)	(0.028)	(0.024)	(0.007)	(0.006)	(0.006)
*LLP*Econ. Capital Add*	0.027			0.081			−0.088***		
	(0.118)			(0.060)			(0.018)		
$\widehat{LLP}$ ∗ *Econ. Capital Add*		−0.232*			0.056			−0.337***	
		(0.140)			(0.067)			(0.027)	
$\widetilde{LLP}$ ∗ *Econ. Capital Add*			0.199			0.163*			0.486***
			(0.130)			(0.093)			(0.035)
Observations	12,769	12,622	12,622	8,365	8,268	8,268	57,911	57,318	57,318
R^2	0.898	0.898	0.898	0.812	0.813	0.810	0.116	0.203	0.064
	Q1,2002 - Q4,2006 (60M CD 100K)			Q1,2007 - Q4,2008 (60M CD 100K)			Q1,2009 - Q1,2014 (60M CD 250K)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
LLP	−0.057			0.178			0.694***		
	(0.126)			(0.110)			(0.034)		
$\widehat{LLP}$		0.486*			0.371***			1.677***	
		(0.261)			(0.104)			(0.046)	
$\widetilde{LLP}$			−0.328**			−0.236			−0.743***
			(0.146)			(0.160)			(0.069)
Econ. Capital Add	−0.028	0.026	0.014	0.052	0.111***	0.101***	0.057***	0.186***	0.077***
	(0.038)	(0.045)	(0.036)	(0.041)	(0.041)	(0.036)	(0.013)	(0.012)	(0.013)
*LLP*Econ. Capital Add*	0.374**			0.064			−0.173***		
	(0.190)			(0.111)			(0.036)		
$\widehat{LLP}$ ∗ *Econ. Capital Add*		−0.035			−0.051			−0.576***	
		(0.372)			(0.109)			(0.049)	
$\widetilde{LLP}$ ∗ *Econ. Capital Add*			0.675***			0.447**			0.880***
			(0.219)			(0.217)			(0.070)
Observations	3,016	2,988	2,988	1,876	1,863	1,863	44,494	44,017	44,017
R^2	0.776	0.777	0.777	0.723	0.724	0.721	0.120	0.218	0.053
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fed. Funds Rate	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Note:									*p<0.1; **p<0.05; ***p<0.01

2.6 Conclusion

Using branch level deposit rate data I examine the effect of accounting information in financial reports on deposit rates. I use deposit rates for partially insured certificates of deposits (CD's) which are most sensitive to the accounting information provided in bank financial reports. I primarily look at how loan loss provisions (both non-discretionary and discretionary) affect deposit rates. I find that overall depositors react more to the direct impact of accounting information on bank profitability and solvency rather than the signaling effect of accounting information observed in the equity and debt markets. I find that higher provisions lead to higher deposit rates, however timeliness in provisioning leads to lower rates. I also find that higher provisions accompanied with high loan growth and high earnings lead to higher deposit rates. Accounting conservatism on the other hand has mixed effects. Conservatism in Allowance for Lease and Loan Losses (ALLL) leads to higher deposit rates, while conservatism in Charge-Offs (CO) results in lower deposit rates.

Within provisions, I find that non-discretionary provisions that have a direct impact on bank profitability and solvency risk are priced by depositors, while the discretionary provisions that signal managements' private information are not priced to the same extent. Moreover, non-discretionary provisions that add to economic capital lead to lower deposit rates, while discretionary provisions that add to economic capital lead to higher deposit rates. These findings attest to the value of accounting information in reducing the information asymmetry between a banks' borrowers and depositors and lends support to the concept of market discipline, a key pillar of the Basel accords.

References

Acharya, Viral V and Nada Mora (2015). “A crisis of banks as liquidity providers”. *The Journal of Finance* 70.1, pp. 1–43.

Acharya, Viral and Hassan Naqvi (2012). “The seeds of a crisis: A theory of bank liquidity and risk taking over the business cycle”. *Journal of Financial Economics* 106.2, pp. 349–366.

Aguirregabiria, Victor, Robert Clark, Hui Wang, et al. (2017). *The Geographic Flow of Bank Funding and Access to Credit: Branch Networks and Local-Market Competition.* Tech. rep.

Ahmed, Anwer S, Bruce K Billings, et al. (2002). “The role of accounting conservatism in mitigating bondholder-shareholder conflicts over dividend policy and in reducing debt costs”. *The Accounting Review* 77.4, pp. 867–890.

Ahmed, Anwer S., Carolyn Takeda, and Shawn Thomas (1999). “Bank loan loss provisions: a reexamination of capital management, earnings management and signaling effects”. *Journal of Accounting and Economics* 28.1, pp. 1–25.

Aiyar, Shekhar, Charles W Calomiris, and Tomasz Wieladek (2012). *Does macro-pru leak? Evidence from a UK policy experiment.* Tech. rep. National Bureau of Economic Research.

Allen, Franklin, Elena Carletti, and Robert Marquez (2015). “Deposits and bank capital structure”. *Journal of Financial Economics* 118.3, pp. 601–619.

Balboa, Marina, Germán López-Espinosa, and Antonio Rubia (2013). “Nonlinear dynamics in discretionary accruals: An analysis of bank loan-loss provisions”. *Journal of Banking & Finance* 37.12, pp. 5186–5207.

Basel III, BCBS (2013). “The Liquidity Coverage Ratio and liquidity risk monitoring tools”. *Bank for International Settlements.*

Beatty, Anne, Sandra L. Chamberlain, and Joseph Magliolo (1995). “Managing Financial Reports of Commercial Banks: The Influence of Taxes, Regulatory Capital, and Earnings”. *Journal of Accounting Research* 33.2, pp. 231–261.

Beatty, Anne and Scott Liao (2011). “Do delays in expected loss recognition affect banks’ willingness to lend?” *Journal of Accounting and Economics* 52.1, pp. 1–20.

— (2014). “Financial accounting in the banking industry: A review of the empirical literature”. *Journal of Accounting and Economics* 58.2, pp. 339–383.

Beaver, William H and Mohan Venkatachalam (1999). "Differential pricing of discretionary, nondiscretionary and noise components of loan fair values". *Nondiscretionary and Noise Components of Loan Fair Values.*

Beaver, William and Ellen Engel (1996). "Discretionary behavior with respect to allowances for loan losses and the behavior of security prices". *Journal of Accounting and Economics* 22.1, pp. 177–206.

Beck, Paul J and Ganapathi S Narayanamoorthy (2013). "Did the SEC impact banks' loan loss reserve policies and their informativeness?" *Journal of Accounting and Economics* 56.2, pp. 42–65.

Ben-David, Itzhak, Ajay Palvia, and Chester Spatt (2017). "Banks' internal capital markets and deposit rates". *Journal of Financial and Quantitative Analysis* 52.5, pp. 1797–1826.

Berger, Allen N and Christa HS Bouwman (2009). "Bank liquidity creation". *The review of financial studies* 22.9, pp. 3779–3837.

— (2013). "How does capital affect bank performance during financial crises?" *Journal of Financial Economics* 109.1, pp. 146–176.

Berger, Allen N and John Sedunov (2017). "Bank liquidity creation and real economic output". *Journal of Banking & Finance* 81, pp. 1–19.

Berger, Allen N. and Gregory F. Udell (2002). "Small Business Credit Availability and Relationship Lending: The Importance of Bank Organisational Structure". *The Economic Journal* 112.477, F32–F53.

Bhat, Vasanthakumar N (1996). "Banks and income smoothing: an empirical analysis". *Applied Financial Economics* 6.6, pp. 505–510.

Bhattacharya, Sudipto and Anjan V Thakor (1993). "Contemporary banking theory". *Journal of financial Intermediation* 3.1, pp. 2–50.

Bomberger, William A (1993). "Income, wealth, and household demand for deposits". *The American Economic Review* 83.4, pp. 1034–1044.

Bushman, Robert M (2014). "Thoughts on financial accounting and the banking industry". *Journal of Accounting and Economics* 58.2, pp. 384–395.

Bushman, Robert M and Christopher D Williams (2012). "Accounting discretion, loan loss provisioning, and discipline of banks' risk-taking". *Journal of Accounting and Economics* 54.1, pp. 1–18.

— (2015). "Delayed expected loss recognition and the risk profile of banks". *Journal of Accounting Research* 53.3, pp. 511–553.

Calomiris, Charles W. and Charles M. Kahn (1991a). “The Role of Demandable Debt in Structuring Optimal Banking Arrangements”. *The American Economic Review* 81.3, pp. 497–513.

Calomiris, Charles W and Charles M Kahn (1991b). “The role of demandable debt in structuring optimal banking arrangements”. *The American Economic Review*, pp. 497–513.

Calomiris, Charles W and Joseph R Mason (1997). “Contagion and Bank Failures During the Great Depression: The June 1932 Chicago Banking Panic”. *The American Economic Review* 87.5, pp. 863–883.

— (2003). “Consequences of bank distress during the Great Depression”. *American Economic Review* 93.3, pp. 937–947.

Campbel, Tim S and William A Kracaw (1980). “Information production, market signaling, and the theory of financial intermediation”. *The Journal of Finance* 35.4, pp. 863–882.

Chari, Varadarajan V and Ravi Jagannathan (1988). “Banking panics, information, and rational expectations equilibrium”. *The Journal of Finance* 43.3, pp. 749–761.

Chen, Yehning and Iftekhar Hasan (2006). “The transparency of the banking system and the efficiency of information-based bank runs”. *Journal of Financial Intermediation* 15.3, pp. 307–331.

Clair, Robert T (1992). “Loan growth and loan quality: some preliminary evidence from Texas banks”. *Economic Review-Federal Reserve Bank of Dallas*, p. 9.

Collins, Julie H, Douglas A Shackelford, and James M Wahlen (1995). “Bank differences in the coordination of regulatory capital, earnings, and taxes”. *Journal of accounting research*, pp. 263–291.

Cook, Douglas O and Lewis J Spellman (1994). “Repudiation risk and restitution costs: toward understanding premiums on insured deposits”. *Journal of Money, Credit and Banking* 26.3, pp. 439–459.

Council, Federal Financial Institutions Examination (2006). *A User’s Guide for the Uniform Bank Performance Report.*

Dang, Tri Vi et al. (2017). “Banks as secret keepers”. *American Economic Review* 107.4, pp. 1005–29.

Davis, Steven J and John Haltiwanger (1992). “Gross job creation, gross job destruction, and employment reallocation”. *The Quarterly Journal of Economics* 107.3, pp. 819–863.

Davis, Steven J, John C Haltiwanger, Scott Schuh, et al. (1998). "Job creation and destruction". *MIT Press Books* 1.

DeAngelo, Harry and René M Stulz (2015). "Liquid-claim production, risk management, and bank capital structure: Why high leverage is optimal for banks". *Journal of Financial Economics* 116.2, pp. 219–236.

Dechow, Patricia, Weili Ge, and Catherine Schrand (2010). "Understanding earnings quality: A review of the proxies, their determinants and their consequences". *Journal of accounting and economics* 50.2-3, pp. 344–401.

Dell'Ariccia, Giovanni and Pietro Garibaldi (2005). "Gross credit flows". *The Review of Economic Studies* 72.3, pp. 665–685.

Diamond, Douglas W. (1984). "Financial Intermediation and Delegated Monitoring". *The Review of Economic Studies* 51.3, pp. 393–414.

Diamond, Douglas W and Philip H Dybvig (1983). "Bank runs, deposit insurance, and liquidity". *Journal of political economy* 91.3, pp. 401–419.

Diamond, Douglas W and Raghuram G Rajan (2000). "A theory of bank capital". *The Journal of Finance* 55.6, pp. 2431–2465.

— (2001). "Banks and liquidity". *American Economic Review* 91.2, pp. 422–425.

Driscoll, John and Ruth Judson (2013). "Sticky deposit rates".

Egan, Mark, Ali Hortaçsu, and Gregor Matvos (2017). "Deposit competition and financial fragility: Evidence from the us banking sector". *American Economic Review* 107.1, pp. 169–216.

Egan, Mark, Stefan Lewellen, and Adi Sunderam (2017). *The cross section of bank value.* Tech. rep. National Bureau of Economic Research.

Elliott, John A, J Douglas Hanna, and Wayne H Shaw (1991). "The evaluation by the financial markets of changes in bank loan loss reserve levels". *Accounting Review*, pp. 847–861.

FASB (1993). *Accounting by Creditors for Impairment of a Loan: An Amendment of FASB Statements No. 5 and 15.* Financial Accounting Standards Board of the Financial Accounting Foundation.

Foos, Daniel, Lars Norden, and Martin Weber (2010). "Loan growth and riskiness of banks". *Journal of Banking & Finance* 34.12, pp. 2929–2940.

Gatev, Evan and Philip E Strahan (2006). "Banks' advantage in hedging liquidity risk: Theory and evidence from the commercial paper market". *The Journal of Finance* 61.2, pp. 867–892.

Gertler, Mark and Nobuhiro Kiyotaki (2015). “Banking, liquidity, and bank runs in an infinite horizon economy”. *American Economic Review* 105.7, pp. 2011–43.

Goldstein, Itay and Ady Pauzner (2005). “Demand–deposit contracts and the probability of bank runs”. *the Journal of Finance* 60.3, pp. 1293–1327.

Gorton, Gary (1988). “Banking panics and business cycles”. *Oxford economic papers* 40.4, pp. 751–781.

Graham, John R, Campbell R Harvey, and Shiva Rajgopal (2005). “The economic implications of corporate financial reporting”. *Journal of accounting and economics* 40.1-3, pp. 3–73.

Griffin, Paul A and Samoa JR Wallach (1991). “Latin American lending by major US banks: The effects of disclosures about nonaccrual loans and loan loss provisions”. *Accounting Review*, pp. 830–846.

Heitz, Amanda and Ganapathi S Narayanamoorthy (2018). “Creditor Rights and Bank Losses: A Cross-Country Comparison”.

Helwege, Jean, Nicole M Boyson, and Jan Jindra (2017). “Thawing frozen capital markets and backdoor bailouts: Evidence from the Fed’s liquidity programs”. *Journal of Banking & Finance* 76, pp. 92–119.

Herrera, Ana Maria, Marek Kolar, and Raoul Minetti (2011). “Credit reallocation”. *Journal of Monetary Economics* 58.6-8, pp. 551–563.

Holmstrom, Bengt (2008). “Commentary: The Panic of 2007”. *Proceedings-Economic Policy Symposium-Jackson Hole*. Federal Reserve Bank of Kansas City, pp. 263–273.

Holod, Dmytro and Joe Peek (2007). “Asymmetric information and liquidity constraints: a new test”. *Journal of Banking & Finance* 31.8, pp. 2425–2451.

Iyer, Rajkamal and Manju Puri (2012). “Understanding bank runs: The importance of depositor-bank relationships and networks”. *American Economic Review* 102.4, pp. 1414–45.

Iyer, Rajkamal, Manju Puri, and Nicholas Ryan (2016). “A tale of two runs: Depositor responses to bank solvency risk”. *The Journal of Finance* 71.6, pp. 2687–2726.

Jacklin, Charles J and Sudipto Bhattacharya (1988). “Distinguishing panics and information-based bank runs: Welfare and policy implications”. *Journal of Political Economy* 96.3, pp. 568–592.

Jiménez, Gabriel et al. (2017). “Macroprudential policy, countercyclical bank capital buffers, and credit supply: evidence from the Spanish dynamic provisioning experiments”. *Journal of Political Economy* 125.6, pp. 2126–2177.

Jin, Justin Yiqiang, Kiridaran Kanagaretnam, and Gerald J Lobo (2011). "Ability of accounting and audit quality variables to predict bank failure during the financial crisis". *Journal of Banking & Finance* 35.11, pp. 2811–2819.

Kanagaretnam, Kiridaran, Gopal V Krishnan, and Gerald J Lobo (2010). "An empirical analysis of auditor independence in the banking industry". *The Accounting Review* 85.6, pp. 2011–2046.

Kanagaretnam, Kiridaran, Gerald J Lobo, and Dong-Hoon Yang (2004). "Joint tests of signaling and income smoothing through bank loan loss provisions". *Contemporary Accounting Research* 21.4, pp. 843–884.

Kim, Myung-Sun and William Kross (1998). "The impact of the 1989 change in bank capital standards on loan loss provisions and loan write-offs". *Journal of Accounting and Economics* 25.1, pp. 69–99.

Koehn, Michael and Anthony M Santomero (1980). "Regulation of bank capital and portfolio risk". *The journal of finance* 35.5, pp. 1235–1244.

Kothari, Sabino P, Susan Shu, and Peter D Wysocki (2009). "Do managers withhold bad news?" *Journal of Accounting Research* 47.1, pp. 241–276.

Krishnamurthy, Arvind and Annette Vissing-Jorgensen (2012). "The aggregate demand for treasury debt". *Journal of Political Economy* 120.2, pp. 233–267.

— (2013). "Short-term debt and financial crises: What we can learn from US Treasury supply". *unpublished, Northwestern University, May.*

Laeven, Luc and Giovanni Majnoni (2003). "Loan loss provisioning and economic slowdowns: too much, too late?" *Journal of financial intermediation* 12.2, pp. 178–197.

Ma, Christopher K (1988). "Loan loss reserves and income smoothing: The experience in the US banking industry". *Journal of Business Finance & Accounting* 15.4, pp. 487–497.

Martin, Christopher, Manju Puri, and Alexander Ufier (2018). *Deposit Inflows and Outflows in Failing Banks: The Role of Deposit Insurance.* Tech. rep. National Bureau of Economic Research.

Martinez Peria, Maria Soledad and Sergio L Schmukler (2001). "Do depositors punish banks for bad behavior? Market discipline, deposit insurance, and banking crises". *The journal of finance* 56.3, pp. 1029–1051.

Mehran, Hamid and Anjan Thakor (2011). "Bank capital and value in the cross-section". *The Review of Financial Studies* 24.4, pp. 1019–1067.

Meller, Barbara and Norbert Metiu (2017). "The synchronization of credit cycles". *Journal of Banking & Finance* 82, pp. 98–111.

Morris, Stephen and Hyun Song Shin (2002). “Social value of public information”. *american economic review* 92.5, pp. 1521–1534.

Moyer, Susan E. (1990). “Capital adequacy ratio regulations and accounting choices in commercial banks”. *Journal of Accounting and Economics* 13.2, pp. 123–154. ISSN: 0165-4101.

Ng, Jeffrey and Sugata Roychowdhury (2014). “Do loan loss reserves behave like capital? Evidence from recent bank failures”. *Review of Accounting Studies* 19.3, pp. 1234–1279.

Nichols, D Craig, James M Wahlen, and Matthew M Wieland (2009). “Publicly traded versus privately held: implications for conditional conservatism in bank accounting”. *Review of Accounting Studies* 14.1, pp. 88–122.

Nicoletti, Allison Kathleen (2016). “The effects of auditors and regulators on bank financial reporting: evidence from loan loss provisions”. PhD thesis. The Ohio State University.

Park, Sangkyun and Stavros Peristiani (1998). “Market discipline by thrift depositors”. *Journal of Money, Credit and Banking*, pp. 347–364.

Peck, James and Karl Shell (2003). “Equilibrium bank runs”. *Journal of political Economy* 111.1, pp. 103–123.

Pérignon, Christophe, David Thesmar, and Guillaume Vuillemey (2018). “Wholesale Funding Dry-Ups”. *The Journal of Finance* 73.2, pp. 575–617.

Postlewaite, Andrew and Xavier Vives (1987). “Bank runs as an equilibrium phenomenon”. *Journal of political Economy* 95.3, pp. 485–491.

Repullo, Rafael (2004). “Capital requirements, market power, and risk-taking in banking”. *Journal of financial Intermediation* 13.2, pp. 156–182.

Saunders, Anthony and Berry Wilson (1996). “Contagious bank runs: evidence from the 1929–1933 period”. *Journal of Financial Intermediation* 5.4, pp. 409–423.

Stiglitz, Joseph E and Andrew Weiss (1981). “Credit rationing in markets with imperfect information”. *The American economic review* 71.3, pp. 393–410.

Uhlig, Harald (2010). “A model of a systemic bank run”. *Journal of Monetary Economics* 57.1, pp. 78–96.

Von Thadden, Ernst-Ludwig (2004). “Bank capital adequacy regulation under the new Basel Accord”. *Journal of Financial Intermediation* 13.2, pp. 90–95.

Wahlen, James M (1994). “The nature of information in commercial bank loan loss disclosures”. *Accounting Review*, pp. 455–478.

Appendix A. Variable Definitions

Table A. Variable Definitions

Variable	**Definition**
LLP	$Loan\ Loss\ Provisions_t\ /\ Loans_{t-1}$
$\widehat{LLP}$	*Fitted values from LLP model reflecting the non-discretionary component of Loan Loss Provisions related to credit risk in the loan portfolio.*
$\widetilde{LLP}$	*Residual values from LLP model, reflection the discretionary component of Loan Loss Provisions.*
$Timeliness$	*Computed as the incremental R^2 impact of including changes in current and future non-performing loans in explaining LLPs. Higher incremental R^2 indicates low DELR. Incremental R^2 are ranked on distance from mean incremental R^2. Dummy =1 if Timeliness above median, 0 Otherwise*
$PublicBHC$	*Dummy =1 if Bank Holding Company is publicly listed, 0 Otherwise*
$High\ Loan\ Growth$	*Computed as the rank of the distance between the 1-year loan growth for each bank and the median value during that quarter. Dummy =1 if 1-Year loan growth above median, 0 Otherwise*
$EBTP$	$Earnings\ Before\ Taxes\ and\ Provisions_t\ /\ Loans_{t-1}$
$High\ Earnings$	*Computed as the rank of the distance between the 4-quarter moving average of EBTP for each bank and the median value during that quarter. Dummy =1 if 4-quarter moving average of EBTP above median, 0 Otherwise*
NPA	*Non-Performing Assets: Sum of Loans past 90-days and accruing, Loans in non-accrual status, and Other Real Estate Owned*
$ACLA$	$NPA_t/Loans_{t-1}$
$ALLL$	$Allowance\ for\ Loan\ and\ Lease\ Losses_t/NPA_t$
CO	$Net\ Charge-Offs_t/NPA_t$
$ALLL\ Conservatism$	*Computed as the rank of the distance between 4-quarter moving average ALLL measure for each bank and the median value during that quarter. Dummy =1 if ALLL above median, 0 Otherwise*
$CO\ Conservatism$	*Computed as the rank of the distance between 4-quarter moving average CO measure for each bank and the median value during that quarter. Dummy =1 if CO above median, 0 Otherwise*
$LoanConcentration$	*Computed as the Herfindahl-Hirschman index (HHI) for five loan categories, namely Commercial Real Estate (CRE) Loans, Commercial & Industrial (C&I) Loans, Consumer Loans, Agricultural Loans, and Farmland Loans. Dummy =1 if Loan HHI above median, 0 Otherwise*
$CRE\ Loan\ Growth$	*Computed as the rank of the distance between the 1-year CRE loan growth for each bank and the median value during that quarter. Dummy =1 if 1-Year loan growth above median, 0 Otherwise*
C&I Loan Growth	*Computed as the rank of the distance between the 1-year C&I loan growth for each bank and the median value during that quarter. Dummy =1 if 1-Year loan growth above median, 0 Otherwise*
$Cons.\ Loan\ Growth$	*Computed as the rank of the distance between the 1-year Consumer loan growth for each bank and the median value during that quarter. Dummy =1 if 1-Year loan growth above median, 0 Otherwise*
$ALLL\ Ratio$	*(ALLL / 1.25% RWA). ALLL reserves up to 1.25% of Gross Risk Weighted Assets (GRWA) is considered as part of Tier 2 Capital.*
$Econ.\ Capital\ Add$	*Dummy =1 if ALLL Ratio* ≥ 1, *0 Otherwise*

Appendix B. Number of Banks and Branches

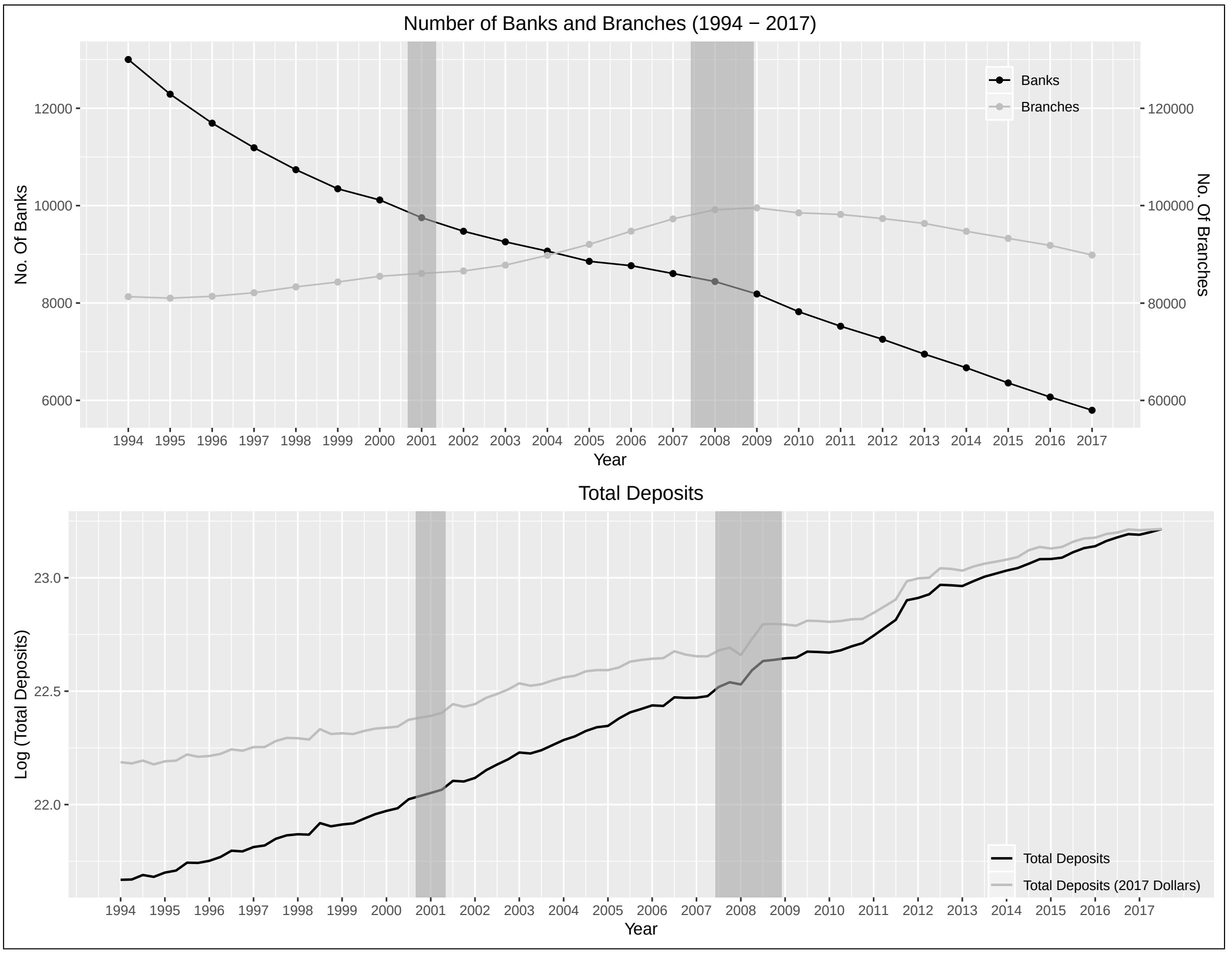

Figure B. Banks, Branches, and Total Deposits (1994 - 2017)

Figure B shows the number of commercial banks, bank branches and total deposits in the US across time periods. The shaded regions are NBER recession periods. We see that while the number of banks have declined from roughly 13,000 in 1994 to almost 5,800 by 2017, the number of branches have remained fairly consistent over time. The number of commercial bank branches actually increased from roughly 81,000 in 1994 to nearly 100,000 in 2009, before declining to almost 89,000 by 2017, albeit still higher than the beginning-of-sample-period levels. It can also be seen that the total deposits in the banking system have been consistently over time, from roughly \$2.5 trillion (\$4.3 trillion in 2017 dollars) in 1994, to nearly \$12 trillion in 2017. While mergers and bank failures have largely been responsible for the consolidation in the banking industry, the entry and exit of individual banks by themselves have little effect on the aggregate deposit flow rates in the banking system.

Vita

Prateek Sharma was born in New Delhi, India. He attended Pune University where he earned a Bachelor of Engineering in Electronics and Telecommunication Engineering, in 2004. Prateek earned a Masters in Finance and a Masters in Statistics from The University of Illinois - Urbana Champaign in 2011, and 2014 respectively. He entered the Ph.D. program in the Finance department at Louisiana State University in 2015. His research interests include banking and regulation, financial intermediaries, and financial accounting and reposting. He is currently a candidate for the degree of Doctor of Philosophy in Business Administration with a major in Finance, which is expected to be awarded in August 2019. Prateek has accepted a visiting assistant professor position at The University of St. Thomas, starting August 2019.