Runs to Banks:

The Role of Cash Sweeps During Market Downturns

DRAFT

September 9, 2020

James R. Barth
Finance Department, Auburn University

Mark Mitchell
CNH Partners, LLC
Booth School of Business, University of Chicago

Yanfei Sun[1]
Finance Department, Ryerson University

ABSTRACT

Sweep deposits from brokerage firms to banks vary inversely with the stock market. When the stock market declines, retail investors reduce risk and sell stocks, with the proceeds typically swept out of brokerage firms and into banks. This result holds for monthly data obtained from a large brokerage firm with affiliated banks and for estimated aggregate quarterly data for sweep deposits across banks. Overall, sweep deposits are a primary driver backing the inverse relation between total bank deposits and the stock market, and are not destabilizing, but instead stabilizing for banks as households reduce risk by converting stock to cash during periods of high stress. They also play a role in the bank lending channel by providing additional funds for loan commitments or credit lines during stressful periods. Absent the recent innovation of sweep deposits swept from brokerage firms to banks, client cash would reside on the balance sheets of brokerage firms and invested in short-dated Treasuries and comparable low-risk securities. Lastly, we find support for the deposits channel in monetary policy, namely that sweep deposits of brokerage clients have a high elasticity to the Federal Funds rate, holding the stock market constant.

[1] Emails: barthjr@auburn.edu, mark.mitchell@chicagobooth.edu, and yanfei.sun@ryerson.ca. The views and opinions expressed are those of the authors and do not necessarily reflect the views of CNH Partners, LLC, its affiliates, or its employees, and they do not constitute an offer, solicitation of an offer, or any advice or recommendation, to purchase any securities or other financial instruments, and may not be construed as such. We thank Jerry Dwyer, Jeremy Getson, Ronen Israel, Leming Lin, Michael Schwert, and Erik Stafford for insightful comments.

Electronic copy available at: https://ssrn.com/abstract=3690525

1. Introduction

There have been numerous stock market downturns over the past century. Most recently, from February 19 to March 23, 2020, the S&P 500 index fell by 34 percent during the COVID-19 pandemic. When these downturns occur, retail funds flow from the stock market to banks as households look to reduce risk. Given the frequency and significance of market downturns, we examine the relationship between the sell-off of stocks and bank deposit flows during such periods.

Our specific focus is on the relatively unique and unexplored role of brokerage firms in sweeping client cash from stock sales to bank deposits during market downturns. Consider the following anecdote. On March 24, 2020, during the early days of the widespread market turmoil due to COVID-19, Charles Schwab Corporation issued $1.1 billion of senior unsecured notes for "… general corporate purposes which may include additional capital to its bank subsidiaries to support balance sheet growth…[due to] the increase in sweep deposits resulting from the de-risking of client portfolios following the sharp increase in market volatility resulting from the COVID-19 pandemic (Fitch, 2020)." Simply put, households sold stocks due to the increase in risk caused by a plummeting stock market, which in effect led to "runs to banks," thereby forcing Charles Schwab Corporation to raise more capital to support its sudden balance-sheet growth.

As far as the history of banking goes, sweep deposits are relatively new. It was only in the 1960s that brokerage firms began placing cash from their customers into deposits at banks. These deposits took the form of certificates of deposit (CDs) and became widely known as brokered deposits (FDIC, 2019). In the late 1970s, brokerage firms started automatically shifting some cash of their customers-- obtained from selling stocks -- into bank deposits, and the transferred funds became known as sweep deposits (Barth and Sun, 2018). When Merrill Lynch began offering this service in early 2000, sweeps to deposits took off (Clark, 2016). Three years later, several online brokerage firms, including Charles Schwab, launched sweep deposit programs for customers (Hamilton, 2005) via the creation of affiliated banks. Absent the innovation of sweep deposits swept from brokerage firms to banks, client cash would reside on the balance sheets of brokerage firms and invested in short-dated Treasuries and comparable low-risk securities.

To our knowledge, there has been no systematic analysis of the role of brokerage firms in serving as intermediaries in channeling funds from stock investors to banks at times when financial

Electronic copy available at: https://ssrn.com/abstract=3690525

markets are under stress. The primary reason for this gap in the banking literature is due to a lack of data.[2] The bank regulatory authorities do not provide information on sweep deposits at individual banks or banks in the aggregate. And according to Tepe (2016), the Securities and Exchange Commission (SEC) does not require broker-dealers to report detailed information on their sweep programs. Despite the lack of publicly available information, we have gained access to actual data on sweep deposits for TD Ameritrade Holding Corporation, a large brokerage firm, and its affiliated banks. We also obtain estimates of sweep deposits data for banks from IDC Financial Publishing (IDC), a private firm that rates the safety and soundness of banks.

Regulators have expressed concern about brokered deposits as early as the 1970s. Their concern stems from the view that brokered deposits are volatile because deposit brokers (on behalf of customers), or the customers themselves, may withdrawal deposits from a bank seeking higher rates elsewhere or when they perceive a bank to be under stress (FDIC, 2019). More generally, according to Clark (2019, p.5), "… brokered deposits, the FDIC has asserted, are held under a third-party structure which increases instability." As a result of their concerns, the FDIC has imposed various restrictions on banks operating with brokered deposits. As regards sweep programs, which constitute a significant component of brokered deposits, Tepe (2016) points out that the systemic risk of such programs depends on the cyclicality of invested funds. Importantly, he adds that broker-dealer sweep programs may decrease the systemic risk for banks by encouraging cash inflows into banks during times of stress. We directly address this issue by examining what happens to not only brokered deposits but especially sweep deposits during market downturns.

Our paper contributes to recent studies that, like our own, examine various factors that lead to changes in deposits. Drechsler, Savov, and Schnabl (2017) show that monetary policy has a strong effect on bank deposits; they find that an increase in the Federal Funds rate triggers large deposit outflows. Li, Ma, and Zhao (2019) develop a conceptual model to predict how bank deposits respond to changes in the supply of U. S. Treasury securities and monetary policy. Their empirical results indicate that an increase in both U. S. Treasury securities and the Federal Funds

[2] According to the FDIC (2011, p.48), for sweeps and referrals from affiliates, data are either incomplete or nonexistent.

Electronic copy available at: https://ssrn.com/abstract=3690525

rate leads to declines in deposits. Neither paper considers another potential deposit channel, namely whether market downturns can affect either brokered or sweep deposits.

In a study closely related to our work, Lin (2020) examines whether market fluctuations transmit to the banking sector through a rebalancing in household portfolios. Lin's results indicate that stock market booms are associated with slower deposit growth due to households' reduced demand for deposits. Lin also finds that the effect is more robust in areas with high stock market participation. Lastly, his results indicate deposit outflows lead banks to reduce lending during stock market booms. Although we adopt some of the methodology taken by Lin, we fill a major gap in the literature by focusing directly on the role of sweep deposits during market downturns.

A related literature focuses on why banks engage in both deposit-taking and providing lines of credit. An influential paper by Kashyap, Rajan, and Stein (2002) makes the straightforward point that deposit-taking and lines of credit are providing the same function, that is, of providing liquidity on demand. In their model, if the demand for liquidity from depositors is not highly correlated with the liquidity demand for borrowers, then banks realize synergies due to needing lower cash balances to serve both sets of customers. Gatev, Schuermann, and Strahan (2009) provide empirical support for the theory that deposits allow banks to manage their liquidity risk, especially during periods of market pullbacks.[3] Their empirical results suggest that investors move funds into deposits during periods of market turmoil. Ivashina and Scharfstein (2010) show that in the aftermath of the failure of Lehman Brothers in 2008, there was a run on banks by corporations which drew down their credit lines. They note that the banks with better access to deposit funding were less likely to cut lending elsewhere.

Our empirical results indicate a robust and negative relation between stock market returns and sweep deposits of customers at TD Ameritrade. More specifically, based on piecewise linear regression results, we find that sweep deposits growth at program banks of TD Ameritrade is significantly related to stock returns when they are negative, but not when the stock returns are positive. This finding indicates that there is an asymmetric relationship between sweep deposits growth and stock returns. We view this result as consistent with the "run to the bank" thesis; that is, as stock markets drop, brokerage customers reduce exposure to risky assets and thereby raise

[3] Also, see related empirical support by Gatev and Strahan (2006). It might be noted that Pennacchi (2006) indicates that investors did not consider deposits a safe haven during times of financial stress prior to the creation of the FDIC.

Electronic copy available at: https://ssrn.com/abstract=3690525

cash, which in turn is swept to banks. And, in the context of the research discussed above, sweep deposits provide funding to banks that are subject to bank runs by corporations drawing down their credit lines during stress periods.

Also, when using aggregate bank data, we find a significant inverse relationship between stock market returns and aggregate cash sweeps. Indeed, the stock-return coefficients for the sweep deposits results are over six times that for the total deposits. Intuitively, to the extent that investors reduce exposure to the stock market during stress periods, the reduction will be magnified as regards sweep deposits due to their origin, namely, brokerage accounts. Our findings also indicate that the stock market variable is not significant in our full-model analysis for total deposits when excluding brokered deposits and sweep deposits, respectively, for the most recent twenty years. Overall, the results suggest that sweep deposits are a primary driver behind the relation between total deposits and stock market activity.

Furthermore, while regulators have historically been concerned about the lack of stability of brokered deposits as a funding source, we find that brokered deposits do not increase overall deposit volatility. Importantly, our results suggest there are notable differences between the impact of sweep deposits versus non-sweep brokered deposits on the overall volatility of bank deposits as a funding source. Indeed, despite their high volatility, sweep deposits are not destabilizing, but instead stabilizing for banks as investors reduce risk by converting stock to cash during periods of high stress. Instead, it is only the non-sweep brokered deposits that appear to sometimes increase the volatility of total bank deposits. Moreover, sweep deposits from brokerage firms serve to enhance the hedging of liquidity risk by banks in providing loan commitments and lines of credit to corporations.

The remainder of our paper proceeds as follows. In the next section, we provide a discussion of the origin and growth of brokered deposits, with a specific focus on sweep deposits, which account for a large proportion of brokered deposits. Section 3 describes the data used in the empirical work, including sources, variables, and summary statistics. The model and empirical results are presented and discussed in Section 4. In Section 5, we analyze the impact of brokered deposits, generally, and sweep deposits, specifically, on the volatility of overall bank deposits. The last section contains our conclusions and suggestions for future research regarding sweep deposits.

Electronic copy available at: https://ssrn.com/abstract=3690525

2. Brokered deposits and sweep deposits

2.1. Brokered deposits[4]

Brokered deposits first appeared in the early 1960s when institutional investors purchased certificates of deposit (CDs) through deposit brokers. Large banks were the first to acquire brokered CDs, regional banks followed in the mid-1970s, and smaller banks turned to CDs in the late-1970s. In 1980, the Depository Institutions Deregulation and Monetary Control Act de-regulated interest rates on deposit accounts and raised the insurance limit from $40,000 to $100,000. In response, brokerage firms such as Merrill Lynch, Dean Witter, Prudential Securities, and Shearson/American Express began offering bank CDs at market rates to retail customers based on the availability of FDIC pass-through insurance to customers up to the new limits.

After these developments, the Gramm-Leach-Bliley Act (GLB), also known as the Financial Modernization Act, became law in 1999 and allowed banks, securities firms, and insurance companies to affiliate under a financial holding company. This regulatory change allowed brokerage firms to sweep customers' balances from money market mutual funds into deposits at affiliated banks. Merrill Lynch was the first brokerage firm to change the default sweep of its Cash Management Account (CMA) from Merrill's CMA Money Fund into Money Market Deposit Accounts (MMDAs) at Merrill Lynch Bank USA or Merrill Lynch Bank & Trust (Pennacchi, 2006).

More generally, with the innovation of CDs, in particular, and the use of brokerage firms, in general, banks could raise funds from savers and investors well beyond their local service markets. There are more than 15 broker-dealers that act as lead underwriters for brokered CDs, with hundreds of others participating, according to Clark (2019). In short, technological and financial innovations have given thousands of banks access to a broader range of alternative funding sources than only deposits obtained through a branch network.

[4] The Appendix contains more detailed information on the origins, definitions, and types of brokered deposits.

Electronic copy available at: https://ssrn.com/abstract=3690525

2.2 Sweep deposits

2.2.a. Sweep deposit mechanics

Brokerage firms may sweep cash in client accounts to banks, some of which are affiliated banks. From a regulatory perspective, sweep deposits are a subset of brokered deposits since they do not originate via a branch model of banking.[5] The default option for brokerage firms is to retain the cash for the benefit of brokerage customers and operations, segregated from their non-brokerage operations. The relationship between a brokerage firm and its clients is governed by SEC Rule 15c3-3, otherwise known as the customer protection rule adopted in 1972.[6] A primary purpose of Rule 15c3-3 is to ensure that brokerages do not use client assets to finance their businesses unrelated to servicing brokerage clients. SEC Rule 15c3-3 stipulates that a brokerage firm must segregate client cash from its other businesses and can only invest that cash in either the financing of margin loans for other brokerage clients or in U.S. Treasuries and similar high-quality securities. Thus, the brokerage firm earns a spread, or net-interest-income, on what it finances in margin loans or invests in U.S. Treasuries relative to the interest the brokerage pays its clients.

An alternative to segregating client funds and investing in U.S. Treasuries is for brokerage firms to sweep client cash off its books and into a bank deposit account, which in turn provides FDIC protection.[7] As already noted, Merrill Lynch popularized bank sweeps in 2000 when it introduced a Bank Deposit Program in its Cash Management Account, where Merrill linked a savings account to a brokerage account (Clark, 2012). While some brokerage firms engaged in bank sweeps before 2000, the Merrill Lynch model of sweeping to an affiliated bank was soon replicated as other brokerage firms began to create and sweep deposits to affiliated banks.

In 2006, Ameritrade Holding Corporation, an online brokerage firm, purchased the retail brokerage subsidiary from TD Bank Group for 39.9 percent of stock in the renamed TD Ameritrade

[5] In a recent paper, Abrams (2019) identifies 15 online direct banks that were founded between 1996 and 2016 and in operation between 2004 and 2018. We find that 13 of these banks have sweep deposits as of 2020.

[6] Customers of brokerage firms are protected by the Securities Investor Protection Corporation (SIPC) if their brokerage firms fail. The protection covers the securities and the cash in the brokerage account up to a total of $500,000, and the cash portion is covered up to $250,000.

[7] Some brokerage firms such as Fidelity and Vanguard also sweep client cash into one of its money-market funds as well as to an unaffiliated program bank. They will generally give the option as to where to sweep the cash to the client. However, most brokerage firms do not provide a money market fund as a sweep option, rather a money market fund is treated just like any other mutual fund. These firms include Charles Schwab, E-Trade Financial, Edward Jones Bank of America Merrill Lynch, Morgan Stanley, and TD Ameritrade (Fonda, 2019). This paper focuses on bank sweep deposits, rather than including money market sweeps, due to the availability of data.

Electronic copy available at: https://ssrn.com/abstract=3690525

Holding Corporation. As part of the transaction, Ameritrade would sweep client cash balances to TD Bank, the U.S. based wholly-owned subsidiary of TD Bank Group. Historically, Ameritrade had segregated client cash at the broker-dealer and invested the cash in U.S. Treasuries, with SIPC protection for the clients. With the new cash sweep arrangement, clients of the newly named TD Ameritrade would receive FDIC protection for cash swept into TD Bank. To give a relative sense of the size of this sweep arrangement, the roughly $150 billion of client cash which TD Ameritrade currently sweeps to TD Bank (and a few other program banks) would place it as the 14th largest bank in the U.S. based on deposits.[8]

An alternative to sweeping to an affiliate bank as in the case of Charles Schwab or via a contractual relation as in the case of TD Ameritrade, brokerage firms can sweep client cash to a network of banks. For example, Interactive Brokers sweeps to up to ten different program banks, thereby providing their brokerage clients with coverage of $2.75 million, which includes $2.5 million of FDIC insurance via the program banks and $250,000 of SIPC cash protection. By sweeping to a diversified portfolio of program banks, the brokerage firm can mitigate client risk in case of an unlikely event of a single bank default. Today, the sweep deposits market has evolved where the brokerage and bank sweep relationship is not merely manufactured in one-off contractual situations, such as the TD Ameritrade relationship with TD Bank, but rather via intermediaries, which creates the network and utility for the respective parties to transact.

Figure 1 shows the relationship between traditional deposits (non-brokered deposits), brokered deposits and sweep deposits. Households, firms and governments can directly deposit funds into their bank accounts, which we refer to as traditional deposits in Figure 1. Alternatively, if a bank utilizes brokers to acquire deposits, the deposits are classified as brokered deposits. Likewise, cash swept into bank deposits by brokerage firms are included within the category of brokered deposits. An exception is if the cash is swept into deposits at affiliate banks of the brokerage firm, the deposits are not classified as brokered deposits so long as they satisfy the "primary purpose" exemption. Thus in general, banking system deposits consist of traditional deposits, deposits classified as brokered deposits (i.e., deposits acquired through a broker and "non-primary purpose" sweep deposits), and "primary purpose" sweep deposits.

[8] Notably, the sweep deposits from TD Ameritrade account for over 40% of the total deposits of TD Bank, making TD Bank the tenth-largest bank based on assets in the U.S., as of 2020.

Electronic copy available at: https://ssrn.com/abstract=3690525

2.2.b Aggregate sweep deposits in perspective

Figure 2 displays aggregate quarterly bank sweep deposits over the period 1984-2020, as well as total domestic deposits and brokered deposits. As illustrated, there were relatively modest increases in all three types of deposits from 1984 to 1999. Starting in 2000, all three deposit measures tended to increase at higher growth rates, with brokered deposits growing more rapidly than domestic deposits and sweep deposits. Per our earlier discussion, Merrill Lynch's introduction of its Bank Deposit Program, where it linked an MMDA account to a brokerage account, followed by several major brokerage firms, contributed to an increase in bank sweep deposits, as displayed in Figure 2. As Pennacchi (2006, p.15) points out, "[d]uring the 5 years from the end of 1999 to the end of 2004, balances in MMDAs grew at a 16.4% annual rate while assets of retail money funds declined at a 3.0% annual rate, a phenomenon that Crane and Krasner (2004) refer to as 're-intermediation'." Also, during the crisis year of 2008, there was a sharp increase in brokered deposits.[9]

Table 1 provides the distribution of domestic deposits, brokered deposits, and sweep deposits among banks in different asset size groups as of the first quarter in 2020. Banks with assets over $50 billion, which we denote as large banks, dominate the various measures of deposits. For example, while the 46 large banks account for less than one percent of all banks, they account for over 72 percent of all domestic deposits. And the large bank concentration is even higher for brokered and sweep deposits, accounting for 78 percent each of both deposit categories.

IDC's estimates of sweep deposits for banks do not include some "affiliated" bank sweeps. In 2005, the FDIC staff issued an advisory opinion that a bank, which accepted sweeps from an affiliated brokerage firm, could under certain circumstances receive an exception from reporting the sweep deposits as brokered deposits.[10] According to the FDIC, 28 depository institutions received $724 billion in funds, as of September 30, 2018, swept from an affiliate broker-dealer

[9] According to Acharya and Mora (2015, pp. 3&5), in 2008, "… the mechanism whereby the banking system as a whole provides backup liquidity to the market by experiencing deposit inflows broke down. This crisis was in fact a crisis of banks as liquidity providers in the aggregate; and not just of the weakest banks. …. [T]he crisis particularly hit banks exposed to drawdowns of commitments and credit lines… These banks … were more likely to seek expensive brokered deposits."

[10] As of July 2017, several restrictions were placed on brokered deposits: (1) well-capitalized banks may accept brokered deposits at any time and pay any rate on those deposits; (2) adequately capitalized banks may accept brokered deposits if they obtain a waiver from the FDIC and pay a rate on the deposits that doesn't exceed the "national rate" plus 75 basis points; and (3) undercapitalized banks may not accept brokered deposits (Barth and Sun, 2018).

Electronic copy available at: https://ssrn.com/abstract=3690525

that would be "primary purpose" exceptions and thus exempt from being reported as brokered deposits (Federal Register, 2019). The inclusion of these $724 billion of affiliate sweeps would have a substantive impact on the proportion of brokered deposits relative to total domestic deposits for 2018Q3, increasing from 8.0 percent to 13.9 percent. And the percentage of sweep deposits would increase from 4.2 percent to 10.1 percent.[11] Thus, brokerage sweep deposits are a far more significant component of bank deposits than as typically represented.

3. Data

This section describes the data sources and measurement of variables used in estimating the empirical model. We use quarterly data for the period 1984Q1[12] to 2020Q1 (henceforth 1984-2020) as well as a shorter period of 2000Q1 to 2020Q1 (henceforth 2000-2020). Our start date of 2000 for the shorter period corresponds to when Merrill Lynch introduced its sweep program, which was soon replicated by other brokerage firms. Also, we use monthly data obtained from TD Ameritrade from November 2009 to March 2020 (henceforth 2009-2020).

3.1. Data sources

We rely on several data sources for the empirical work. The bank variables, except for sweep deposits, come from the Consolidated Reports of Condition and Income, or Call Reports, filed by all banks. The information is available from the Federal Financial Institutions Examination Council (FFIEC) for the period 2001 to present and from the Federal Reserve Bank of Chicago for the period 1984 to 2000. The sweep deposits data for banks are from IDC and for one brokerage firm from TD Ameritrade. Stock return data come from the Center for Research in Security Prices (CRSP). GDP and the Federal Funds rate data come from the Federal Reserve Bank of St. Louis. House price data come from the Federal Housing Finance Agency (FHFA).

3.2. Variable measurement

The deposit variables are measured as growth rates, which include domestic deposits, brokered deposits, and sweep deposits. The primary dependent variable of interest is the growth

[11] An important example is that of Charles Schwab, which as of March 2020 had roughly $247.4 billion in domestic deposits, yet IDC indicates bank sweep deposits of only $16.1 billion. Due to the exempt ruling by the FDIC, Charles Schwab was not required to treat nearly its entire bank sweeps as brokered deposits even though nearly all the cash at Charles Schwab Bank originates at the broker dealer.

[12] Note that the starting point for the deposit levels is 1984Q1, and thus, our return metric starts in 1984Q2.

Electronic copy available at: https://ssrn.com/abstract=3690525

rate of sweep deposits. The stock return data, which is our primary independent variable of interest, are from the monthly stock files of the value-weighted index (VW) of all U.S. listed securities from the Center for Research in Security Prices (CRSP). We compound the monthly returns in each quarter to convert to quarterly returns. Similar to Lin (2020), we also include three control variables: GDP growth, the first difference in the average monthly effective Federal Funds rate in the last month of a quarter, and growth in house prices, which are expressed as growth rates based on the U.S. residential housing price index (all-transactions indexes and not seasonally adjusted).

Since sweep deposit data are not available in the Call Reports, we rely on data obtained from IDC. Sweep deposits are generally based on a calculation in which they are equal to brokered deposits minus the sum of brokered CDs and reciprocal deposits. IDC employs a proprietary algorithm involving several rules and steps to obtain their estimate of sweep deposits. As a check on the accuracy of the estimates, we compared the growth rate for the actual sweep deposits of TD Ameritrade and the estimated sweep deposits at TD Bank from IDC: the correlation coefficient is 0.70 and highly significant. In the next section, we provide evidence that the sweep data estimated by IDC for TD Bank yields similar estimates to the actual sweep data from TD Ameritrade.

3.3. Summary statistics

Table 2 provides summary statistics for the variables used in our empirical analysis. For the longer period, 1984-2020, there are 144 quarterly observations (Panel A), while for the shorter period 2000-2020, there are 81 quarterly observations (Panel B). In the case of TD Ameritrade (Panel C), there are 125 monthly observations over the 2009-2020 period. There are no notable differences in the data across Panels A and B, while the data in Panel C is monthly and not directly comparable to that in the other two panels.

Over the longer period, sweep deposits grew an average quarterly rate of 3.4 percent as compared to 3.5 percent for brokered deposits and 1.3 percent for total domestic deposits. The quarterly standard deviations of sweep deposits (10.7 percent) and brokered deposits (14.1 percent) are far higher than the quarterly standard deviation of total domestic deposits at 1.6 percent. Due to a few extreme outliers for brokered deposits and sweep deposits during the first few years of the sample period, we winsorize the growth rates for both series at the 2.5 percentile and the 97.5

Electronic copy available at: https://ssrn.com/abstract=3690525

percentile in the subsequent empirical tests.[13] Our concern is that some of the extreme outliers may occur due to the estimation error of sweep deposits by IDC. We do not winsorize the growth rates for total domestic deposits as the time series of total deposits does not exhibit extreme outliers. Likewise, we do not winsorize any of the data series for the independent variables, as most of them do not indicate substantial differences from normality. An exception is the difference in the Federal Funds rate, which is highly non-normal, but we choose not to winsorize the Federal Funds rate difference as its distribution is consistent with economic reality.

4. Model specification and empirical results

4.1. Empirical model

The basic empirical model is:

$$deposit\ growth_t = \alpha + \beta_1 return_t + \beta_2 return_{t-1} + \gamma_1 X_t + \gamma_2 X_{t-1} + \epsilon_t,$$

where *deposit growth* is the growth of different types of deposits, including total domestic deposits, brokered deposits, sweep deposits, domestic deposits minus brokered deposits, domestic deposits minus non-sweep brokered deposits, and domestic deposits minus sweep deposits. [14] The model is estimated with monthly data for sweep deposits from TD Ameritrade over the period 2009-2020 and is estimated for the different types of aggregate deposits using quarterly data for two periods, 1984-2020 and 2000-2020. *Return* is the CRSP VW stock return and *X* reflects the control variables, including GDP growth, change in the effective Federal Funds rate, and residential house price growth. All independent variables are measured in the quarter or month t and t−1, respectively. We first discuss the empirical results for TD Ameritrade and then turn to those for all banks.

4.2. Sweep deposits from TD Ameritrade

TD Ameritrade, a large brokerage firm, sweeps most of its client cash to TD Bank based on a long-term contractual relationship. Table 3 provides regression estimates for 2009-2020,

[13] Note that while the winsorizing modestly reduces the standard errors associated with some of the regression coefficients, this process does not alter the coefficient estimates or any of the conclusions reached.

[14] The empirical model is similar to Lin (2020). After becoming aware of Lin's work on total bank deposits, we decided to alter our empirical model to reflect the control variables employed in his study, so as to allow for a more controlled examination of the influence that sweep deposits have on the impact of the response of total deposits to the stock market.

Electronic copy available at: https://ssrn.com/abstract=3690525

where the dependent variable is the monthly sweep deposits growth rate for the customers of TD Ameritrade.[15] Column 1 displays the simple regression with the contemporaneous stock market return as the independent variable. The coefficient estimate is -0.433 and is highly statistically significant (p-value < 0.001) with a standard error of 0.089. Thus, a 10.0 percent reduction in the stock market results in a 4.33 percentage point increase in the sweep deposits growth rate, which is more than three times higher than the average monthly sweep growth rate of 1.38 percent. When the stock market declines, brokerage customers of TD Ameritrade reduce risk and sell stocks,[16] thereby raising cash, which in turn is swept to TD Bank.

Following the transaction with TD Bank, TD Ameritrade continued to make large acquisitions as part of its consolidation strategy, with ThinkorSwim in 2009 and ScottTrade in 2017. Clients of ThinkorSwim and ScottTrade were converted to the TD Ameritrade platform in January 2010 and February 2018, respectively. Contemporaneous with the conversions, TD Ameritrade also began to sweep cash balances held by the former clients to TD Bank. For both acquisition-conversion months, the cash sweep deposit balances for TD Ameritrade increased much higher than the full-sample monthly average of 1.38 percent, that is, 14.07 percent and 32.12 percent for the ThinkorSwim and ScottTrade conversions, respectively.

Figure 3 displays a scatterplot of the monthly sweep deposits growth rate of TD Ameritrade's clients and the monthly CRSP VW stock return. In addition to highlighting COVID-19 (March 2020), Figure 3 also references the conversion months for ThinkorSwim and ScottTrade. As shown, both acquisition conversions occurred during months in which the stock market declined, thus artificially biasing the coefficient for the stock market return by showing stronger results. Column 2 displays the regression results after we delete these two observations. As expected, the coefficient on the stock market return declines from -0.433 to -0.337, albeit with no reduction in statistical significance as the standard error declines by a larger relative amount, thereby actually increasing the significance level. The regression line estimate in Figure 3 is from

[15] TD Ameritrade, like other brokerage firms of which we are aware of, does not report monthly sweep data in their quarterly and annual filings. Rather, they tend to report either average sweep balances over the quarter or end-of-quarter sweep balances, and not always in a consistent manner. While TD Ameritrade commenced its bank sweep program at the end of 2006 with TD Bank, the company was unable to provide us with comparable monthly data during the three-year period leading up to October 2009.

[16] We are using stocks as a generic term for stocks, bonds, mutual funds, etc. An analysis of which securities that retail investors choose to sell during market downturns is not covered in this paper.

Electronic copy available at: https://ssrn.com/abstract=3690525

the Column 2 regression results and thus reflects the -0.337 estimate.[17] We also note that the COVID-19 March 2020 observation does not materially alter the results as the level of significance remains at 0.01 if excluded.

Column 3 adds a lagged market return to the Column 2 regression model. We do so for three reasons. First, we do not have strong priors that investor behavior should fully adjust the risk of their portfolios in the same month as the stock market returns, especially if a large market movement occurred near the end of the month. Second, for most stock trades, the settlement occurs two business days after the trade executes, and the cash is swept from the brokerage firm to the bank on the settlement date.[18] Thus, the date on which the sweep deposit occurs could be in the subsequent month after the trade occurred. And, in the case of TD Ameritrade, the sweep deposit contract permits TD Bank to stagger the acceptance of large sweep deposits.

As shown in Column 3, the inclusion of the lagged market return yields substantially higher explanatory power of the regression model. The coefficient on the lagged market return is -0.183 and is highly significant (p-value = 0.006) with a standard error of 0.066. Moreover, the coefficient on the contemporaneous stock market return does not decrease in size, instead increases slightly from -0.337 to -0.347, and with a slight reduction in the standard error.[19]

In Column 4, we add three control variables in monthly terms: GDP growth rate, change in the effective Federal Funds rate, and the Housing Index growth rate. The coefficient for the GDP growth rate variable is -1.189 and highly significant (p-value = 0.006). A one-percentage-point increase in the GDP growth rate leads to a 1.19 percentage points decrease in the sweep deposits growth rate, which reduces the mean sweep deposits growth rate to 0.21 from 1.38

[17] We noted earlier that we winsorize the aggregate sweep growth rates due to our concern of extreme outliers caused by IDC estimation errors. However, we did not winsorize the Ameritrade sweep growth rates as we have sufficient information about the outliers and thus eliminate observations from the regression model where justified. Moreover, we are not concerned about the estimation error of the Ameritrade sweep deposits as they are subject to rigorous internal and external auditing controls.

[18] The settlement period switched from three trading days to two trading days in 2017, and from five trading days to three trading days in 1995.

[19] Note, using the Newey-West estimator to address autocorrelation and heteroskedasticity in the error terms does not diminish the significance level of the results.

Electronic copy available at: https://ssrn.com/abstract=3690525

percentage points. Thus, retail brokerage investors at TD Ameritrade rotate out of stocks and into cash when GDP growth declines, independent of stock market returns.[20]

We use the first difference in the effective Federal Funds rate as our measure of monetary policy.[21] The coefficient on the change is significant and negative for both the contemporaneous and the lagged variables. Using the sum of coefficients on the contemporaneous and lagged Federal Funds change in Column 4, a 25 basis-point increase in the change in the Federal Funds rate results in a 4.35 percentage point, or three times, slower growth rate in sweep deposits arranged by TD Ameritrade.[22]

While our focus is on the relationship between the stock market and sweep deposits, the economic magnitude of the Federal Funds rate on sweep deposits is interesting. Clients at firms such as TD Ameritrade tend to receive low rates on their sweep deposits, typically below 10 basis points, and are willing to do so for convenience. However, when the Federal Funds rate increases, thereby leading to increases in money market rates, brokerage clients actively opt to transfer their excess cash into money market funds as implied by the coefficients on the Federal Funds rate variable. The results are consistent with recent research by Drechsler, Savov, and Schnabl (2017), who provide support for the deposits channel in the transmission of monetary policy. They find that when the Federal Funds rate increases, banks widen the net interest margin, and consumers respond by moving deposits out of the banking system. We report a much higher response by brokerage customers than as detailed in their dataset of bank deposits.

Overall, the Column 4 regression results convey a robust relation between stock market returns and sweep deposits arranged by TD Ameritrade. The coefficients on both the contemporaneous and lagged stock market returns are statistically significant at the 0.01 level, and both coefficients are economically significant as well. And despite utilizing only the data from a

[20] Though not the focus of this research, we find it interesting of the behavioral aspect of retail investors to economy wide changes, holding the stock market constant, especially given the high elasticity of these investors to the stock market.

[21] See, for example, Kashyap and Stein (2000), Gomez, Landier, Sraer and Thesmar (2020), and Lin (2020), who also employ the change in the Federal Funds rate as a measure of monetary policy. We document similar results if we use the difference in the 30-day U.S. Treasury yield instead.

[22] The average monthly change (in absolute value) over the months corresponding to the TD Ameritrade data is only four basis points.

Electronic copy available at: https://ssrn.com/abstract=3690525

single brokerage firm and only a decade of monthly data, the overall explanatory power is more than 0.50 for cash sweeps.

In addition to the two brokerage acquisition conversion months, Figure 3 also highlights COVID-19 in March 2020 when TD Ameritrade sweep deposits balance increased 26.5 percent, from $122.1 billion to $153.4 billion, as the stock market declined 13.8 percent. While sweep deposits grow in most months, 79 of the 125 monthly observations, for the TD Ameritrade data, the growth rates are higher when the stock market declines, as indicated by the regression results in Table 3. For example, the average monthly sweep growth is 2.58 percent when the stock market return is negative versus 0.51 percent growth during those months when the market increases.

The negative relation between the growth of sweep deposits and the stock market appears to be predominately driven by those months in which the market declined. Figure 4 reproduces the scatterplot of Figure 3, excluding the two acquisition-conversion months, which biased the regression results. Whereas Figure 3 displays the slope from a linear regression model, Figure 4 shows the results from a piecewise linear regression with a zero stock market return as the breakpoint.[23] The slope coefficient is -0.757 (p-value < 0.001) when the market return is negative, thus well over two times the coefficient for the linear model in Column 2 of Table 3. And for those months in which the stock market increased, the slope coefficient is positive (0.091) rather than negative, and insignificant. Also, the R-squared for the piecewise linear model in Figure 4 increases to 0.31 from 0.19 in Figure 3.[24] Overall, these results suggest, that at least for TD Ameritrade, brokerage clients run to the bank in the form of cash sweeps during market downturns, but do not run from the bank to buy stocks when markets increase.

4.3. Aggregate sweep deposits and stock market returns

The TD Ameritrade data provides striking evidence of the strong relationship between sweep deposits and stock market activity, as well as between sweep deposits and the Federal Funds rate. Our rationale for using the data from a single brokerage firm was not simply due to the monthly level of reporting, but more so because we have full confidence in the data validity. The purpose of this section is to assess whether the clinical results from the TD Ameritrade analysis

[23] The zero breakpoint is chosen to examine the relationship over two regimes, one with positive and the other with negative stock returns.
[24] The results are essentially unchanged when omitting the COVID-19 month.

Electronic copy available at: https://ssrn.com/abstract=3690525

generalizes to a much larger dataset of sweep deposits which are estimated on the banking side, albeit with estimation error.

As discussed in the Data section, we obtain the sweep deposits data from IDC Financing Publishing (IDC). IDC employs a proprietary algorithm to estimate sweeps deposits within brokered deposits, which banks report to the Federal Financial Institutions Examination Council (FFIEC) via Call Reports, which are mandated quarterly reports containing detailed accounting, financial, and deposit data for banks. The Call Report data are available quarterly starting in 1984. Our variable of interest is the rate of change in sweep deposits; thus, the first observation for the empirical analysis is the second quarter of 1984 and extends through the first quarter of 2020. We noted in the Data section that we would also analyze the behavior of sweep deposits over a period starting in 2000 corresponding to when Merrill Lynch introduced its sweep deposit program that was soon replicated by other brokerage firms.

Table 4 displays the regression results for the aggregate sweep deposits of all banks in a similar format to the TD Ameritrade regressions in Table 3. All variables are measured quarterly, and in growth rates, except for the Federal Funds rate, which is measured as the first difference. Columns 1-3 report the results for the full-time period and Columns 4-6 for the period starting in 2000. We winsorize the sweep deposit growth rates at the 2.5 percent and 97.5 percent confidence levels due to a few extreme outliers in the early part of the sample period.

The coefficient estimate for the stock market return in Column 1 is -0.162 percent (p-value = 0.076). We find that the addition of the lagged stock market return increases the overall explanatory power of the regression. The coefficient size and significance of the contemporaneous stock return variable in Column 2 is invariant to the addition of the lagged return, and the sum of the two coefficients is -0.290 (p-value = 0.030). The addition of the control variables in Column 3 has a noticeable impact on the explanatory power of the regression model and, importantly, on the significance of the impact variables.[25] The coefficient estimate on the stock market return is -0.252 (p-value = 0.009) and is -0.183 (p-value = 0.057) on the lagged stock market return variable.

[25] Note that there is a general lack of significance of the control variables included in the regressions for the two periods in Table 4. This is undoubtedly due to correlations among these variables, as shown in Panels A and B of Table 5. The pairwise correlations among the six different control variables, GDP growth, change in the Federal Funds rate, and growth in house prices and their lagged values are in almost all cases highly significant. The lack of significance for these variables, moreover, is similar to that reported by Lin (2020) for total deposits.

Electronic copy available at: https://ssrn.com/abstract=3690525

Thus, for the full sample, there appears to be a strong and reliable inverse relationship between stock market returns and aggregate cash sweeps over the 1984-2020 sample period.

The shorter period estimates in Column 4-6 convey more reliable results than for the full sample period. Across all three regression models, the coefficients on the contemporaneous stock market return increase substantially in absolute size and statistical significance, albeit with a much smaller sample size at 81 quarterly observations versus 144 for the full sample. Moreover, the size of the coefficient on the stock market variable is comparable to that for the TD Ameritrade regression results. We view these results consistent with the "run to the bank" thesis; that is, as stock markets drop, brokerage customers reduce exposure to risky assets and thereby raise cash, which in turn is swept to banks. However, we do note that the non-linear relation we document for the TD Ameritrade data does not generalize to the larger data set.[26]

While it is the case that the TD Ameritrade deposit sweep relationship with the stock market generalizes to the aggregate sweep deposits market, the aggregate results are weaker than expectations, given the TD Ameritrade evidence. That is, our priors are that with a longer sample and the portfolio effect of averaging over a large number of banks, the empirical results would be stronger for the aggregate sweep dataset. Three potential factors are at play: (1) monthly versus quarterly rates, (2) mismeasurement of sweep data by IDC, and (3) sample selection bias with TD Ameritrade data. We analyze the first two factors below. Concerning the third factor, TD Ameritrade provides an investing and trading platform for the self-directed investor. We do not rule out the possibility that its brokerage clients are more responsive to the stock market and changes in monetary policy. Indeed, TD Ameritrade customers may be indicative of how many brokerage customers have changed their behavior over time. It has become far easier and much cheaper to trade – so people can trade and react more frequently in shorter time periods. TD Ameritrade probably captures more of this behavior than the aggregate as a whole. More generally, easier (e.g., ease of trading ETFs) and cheaper trading leads to more frequent adjustments in

[26] Specifically, the non-linear model results are not robust across the various sample periods and across certain sub-samples. For example, similar non-linearity exists for the full-sample period of aggregate data, but not for the more recent 20-year period which we focus on (in fact, it reverses for the more recent period). And it exists for the sub-sample of the 25 largest banks, as measured by sweep deposits, but not for the 10 or 50 largest banks.

Electronic copy available at: https://ssrn.com/abstract=3690525

exposures/risk so that people trade more in volatile periods in the shorter sample than they did in the earlier sample. [27]

Panel A of Table 6 is mostly a replication of the regression models for TD Ameritrade in Table 3. Table 6 uses quarterly data rather than monthly data in Table 3 since the IDC aggregate sweep deposit data are quarterly. Whereas the first observation in Table 3 was November 2009, the first observation in Table 6 is the first quarter of 2010, thus Table 6 does not include the first two observations used in Table 3. Otherwise, the regression format is identical except for the use of quarterly data versus monthly data. For example, in Columns 2-4, we also exclude the two quarters in which the large acquisitions occurred, thereby removing the observations that were biasing the regression coefficients for the variables of interest in favor of statistical significance.

Across all four quarterly regression models in Panel A of Table 6, the coefficient estimate on the stock market return is of similar size and significance as in the monthly regressions, despite the much smaller sample at only 39 to 41 observations, depending on the regression model. We interpret this evidence to suggest that the adjustment by retail investors to market moves is not temporary (i.e., simply over a one-month window), but instead holds for longer periods such as three months. Indeed, the R-squared increases to 0.79 for the quarterly regression with all the control variables.

The other noteworthy finding in Panel A of Table 6 pertains to the lagged difference in the Federal Funds rate. We reported -17.380 for the sum of the coefficients on the contemporary and lagged difference in the Federal Fund rate in the monthly regressions (Table 3), whereas in this case, the sum of coefficients reaches to -20.788 in the quarterly regression model and with high statistical significance (p-value < 0.001).[28] A 25 basis-point increase in the change of the Federal Funds rate results in a significant 5.2 percentage point decrease in the sweep deposits growth rate of clients at TD Ameritrade. When the Federal Funds rate increases, thereby leading to increases in money market rates, brokerage clients subsequently transfer their excess cash into money market funds to obtain higher yields than the minimal return paid on cash balances at TD Ameritrade. As we noted earlier, these results are consistent with Drechsler, Savov, and Schnabl

[27] Note however that we don't have priors that clients of TD Ameritrade behave differently to market movements and monetary policy changes than clients of other brokerage firms which sweep client cash to banks.
[28] It should be noted that there is high autocorrelations for changes in the Federal Funds rate. However, this does not impact our variable of interest, which is the stock market returns.

Electronic copy available at: https://ssrn.com/abstract=3690525

(2018), who provide support for the deposits channel in the transmission of monetary policy. Again, we note a far higher response by brokerage customers than that reported in their dataset of bank deposits.

The next factor, which can potentially explain the weaker results for the aggregate sweep deposits versus the TD Ameritrade data, is that the IDC estimates of sweep deposits are subject to measurement error. As we described in the Data section, IDC employs a proprietary algorithm to estimate sweep deposits based on various components of brokered and other deposits. Though not broken out separately in the financial reports which banks prepare for the FFIEC, qualified sweep deposits of banks coming from affiliated brokerage firms are not included within brokered deposits, which are deposits obtained via third parties.

We can provide insight into possible IDC measurement error of sweep deposits by comparing the TD Ameritrade quarterly values of sweep deposits to the IDC estimates of sweep deposits for TD Bank. Recall from our earlier discussion that TD Bank is a U.S. based bank and wholly-owned by TD Bank Group. Per a long-term contractual agreement, TD Ameritrade sweeps virtually all of its client cash deposits to one of two charters, TD Bank N.A. and TD Bank USA, held by TD Bank. A recent exception is that TD Ameritrade began in 2018 to sweep some of its uninsured deposits to banks other than TD Bank. Due to our information from TD Ameritrade, we can adjust for the relatively small amount of sweep deposits to other banks.[29] Importantly, TD Bank only accepts sweep deposits from TD Ameritrade. Thus, the TD Bank sweep deposits as calculated by IDC should mimic the sweep deposits provided by TD Ameritrade.

Figure 5 provides a bar chart of the TD Ameritrade quarterly sweep deposits (in billions of dollars) during 2009-2020 based on the two sources, direct from TD Ameritrade and as estimated by IDC based on Call Report data. The bar chart conveys a strong relationship between the two measures of sweep deposits in levels: the correlation coefficient is 0.98. However, our

[29] The original 2006 agreement, as amended and extended various times over the years, permits TD Ameritrade to sweep uninsured cash balances to banks other than TD Bank. For example, a client with $1 million in cash would only be insured for $500,000, that is, $250,000 from each of the two TD Bank charters. TD Ameritrade began to sweep uninsured deposits away from TD Bank, which amount to less than 10 percent of its total cash balances. In our comparisons to the IDC data which estimates TD Bank sweep deposits, we include only the TD Ameritrade funds that are swept to deposits at TD Bank.

Electronic copy available at: https://ssrn.com/abstract=3690525

measure of interest, the growth rate of sweep deposits, exhibits a significantly lower correlation coefficient at 0.70, as noted earlier, suggesting moderate misestimation of sweep deposits by IDC.

To further assess the impact of the measurement error in the IDC sweep deposits for clients of TD Ameritrade, Panel B of Table 6 displays regression coefficients using the TD Bank sweep deposits estimates. The coefficient estimates on the stock market return variable are similar to the coefficient estimates in Panel A, where we use the sweep deposits values obtained from TD Ameritrade values. However, a comparison of the R-squares in the full-model Column 4 estimates indicates a sense of the measurement error: Panel A R-squared is 0.79 versus 0.64 for Panel B. Moreover, the lagged Federal Funds rate variable, which is economically large and highly significant in Panel A regression, is insignificant in Column 4 of Panel B.

Our overall assessment, based on the TD Ameritrade sweep deposit values, is that the empirical results from the IDC estimates of aggregate sweep deposits likely understates the real impact of stock returns on sweep deposits. We have no reason to believe that the IDC estimates are biased in any direction, rather just nosy estimates of the actual underlying sweep deposits. However, as we discuss below in Section 4.4, the lack of reporting sweep deposits by affiliated banks has a material impact on how sweep deposits affect the response of total deposits to stock market movements.

4.4. Deposit types and the stock market

While the focus of our paper is on sweep deposits, it is important to take note of whether the findings yield insight into related work on banking deposits in general. The paper most related to our empirical design is by Lin (2020), who documents that slower bank deposit growth is related to stock market booms. Indeed, as noted earlier, while we did not become aware of Lin's work until after our preliminary research analysis, we adopted some of Lin's empirical methodology, such as the three before-mentioned control variables.

Table 7 provides regression estimates of the impact of the stock market on various measures of deposits, including total deposits, brokered deposits, and sweep deposits, as well as total deposits minus brokered deposits and sweep deposits, respectively. Following Lin (2020), we use the start date of 1984 for the full-sample regressions, and in conjunction with some of our prior analyses, we also include the results with a start date of 2000 when sweep deposits became

Electronic copy available at: https://ssrn.com/abstract=3690525

more prevalent. Our end sample date is 2020 versus 2017 for Lin's analysis, but in unreported results, this data addition does not materially influence the overall results.

For each deposit measure, Table 7 provides coefficients for two regression models, one with just the contemporaneous stock market return and lagged stock market return. The second regression model includes the three control variables, as in the case of some of the prior tables, also with lags for the control variables. Our discussion will focus only on the full regression model results. The total deposit results, as displayed in the first two columns, are virtually identical to the results reported by Lin (2020).[30] The contemporaneous (lagged) stock market return is significant at the 0.05 (0.10) level for the total deposits regression. A 10 percent decrease in the stock market is associated with a 0.40 percentage point increase in the total deposits growth rate for the contemporaneous quarter and a 0.30 percentage point increase in the total deposits growth rate the subsequent quarter. As a comparison, the average quarterly total deposit growth rate is 1.3 percent (Table 1).

As we discussed in Section 2, sweep deposits are one type of brokered deposits. The definition of brokered deposits has changed over the years. Generally, it is viewed as any deposit obtained directly or indirectly with the assistance of a third party, otherwise known as a deposit broker for these purposes. Columns 3 and 4 display the regression estimates for brokered deposits. The coefficient on the stock market return is comparable to what we saw with the sweep regression results in terms of both size and significance. Some of the control variable coefficients are also significant, but we do not discuss them as the significance disappears in the Panel B regressions.

The sweep deposit regressions appear in Columns 5 and 6 and are the same as displayed in Table 4 and discussed in Section 5.3. As we indicated in that discussion, the contemporaneous and lagged stock market return variables in the full regression are economically large and statistically significant. A 10 percent decrease in the stock market is associated with a 2.52 percentage point increase in the total deposits growth rate for the contemporaneous quarter and a 1.83 percentage point increase in the total deposits growth rate the subsequent quarter. The sum of the stock-return coefficients for the sweep deposits regression is over six times that for the total

[30] Note that when we employ the same end date, or 2017 as Lin (2020), the results are identical.

Electronic copy available at: https://ssrn.com/abstract=3690525

deposits regression. Intuitively, to the extent that investors reduce exposure to the stock market during stress periods, the reduction will be magnified in the sweep deposits due to their origin, namely, brokerage accounts.

The last four sets of regressions in Panel A involve total deposits minus brokerage deposits and sweep deposits, respectively. While there is a modest decline in the coefficient size and significance of the stock return variables, the results are consistent with Lin's (2020) research that bank deposits generally covary negatively with stock market returns.

As discussed in Section 3, we also examine the impact of the stock market on sweep deposits for a period starting in 2000 when Merrill Lynch popularized sweep deposits for large brokerage firms. Panel B of Table 7 provides the regression results for the five different measures of deposits during 2000-2020. Again, we describe the results only for the full model regressions. For the total-deposits regression, the stock market return coefficient is of similar magnitude at -0.038 and significant at the 0.10 level. The lagged stock market coefficient is much smaller than for the full sample, positive but insignificant, and the sum of the two stock market coefficients is not significantly different from zero.

As with the full-sample results, the stock market variable is highly significant for brokered deposits, as well as sweep deposits which we showed earlier, over the 2000-2020 period. The main takeaway from Panel B is that the stock market variables are no longer significant for total deposits when excluding brokered deposits and sweep deposits, respectively. Notwithstanding the lack of significance, we do note that the coefficient estimates do not change in size dramatically. While insignificant, the decline in significance is not large relative to the total deposit regressions. However, the results do suggest that sweep deposits are a primary driver behind the relation between total deposits and stock market activity. And importantly, as we noted earlier, sweep deposits are substantially underreported by IDC since qualified-affiliate sweep deposits are excluded from brokered deposits in the reporting to the FFIEC and subsequently indicated in the Call Reports. For example, as already noted, the FDIC indicated in September 2018 that the total amount of sweep deposits from affiliated brokerage firms was $724 billion versus the IDC estimate of $516 billion for sweep deposits from non-affiliated brokerage firms. Thus, at least towards the end of the sample period, the estimated sweep deposits understate the actual sweep deposits by a factor of greater than two. Under the assumption that affiliate sweep deposits behave similarly to

Electronic copy available at: https://ssrn.com/abstract=3690525

non-affiliate sweep deposits, it is our view that the relation between non-sweep deposits and the stock market would diminish further if all sweep deposits were measured as such.[31]

The primary finding from our research, namely that sweep deposits exhibit significantly high growth rates during stock market declines, also implies that sweep deposits from brokerage firms play an important role in the synergistic benefits of combining the two liquidity provision functions of banks since corporations are known to seek liquidity during periods of high economic stress. This is consistent with the earlier work of Kashyap, Rajan, and Stein (2002), who provide theoretical and empirical support for why banks provide both deposit-taking and credit lines. They start with the recognition of prior research supporting the rationale for both services being undertaken by an intermediary as opposed to arm's-length transactions in securities markets.[32] Importantly, in their model of a bank, Kashyap, Rajan, and Stein show that if the demand for deposits is not highly correlated with the demand by corporations to draw on their credit lines, the combining of these two services generates synergies due to a reduction in the cash balance held to serve both sets of customers.

Gatev and Strahan (2006), moreover, provide additional empirical support for Kashyap, Rajan, and Stein by showing that when liquidity shocks occur in the commercial paper market, deposit inflows increase at banks. The additional deposits allow banks to meet loan demand from borrowers drawing down loan commitments without running down their cash balances. And Ivashina and Scharfstein (2010) show that in the aftermath of the failure of Lehman Brothers in 2008, there was a run on the bank by corporations which drew down their credit lines. Likewise, large corporations across the board drew down their credit facilities in March 2020 during the height of the COVID-19 fears when volatility spiked to historical levels.[33] The inflow of sweep deposits from brokerage firms significantly contributes to the bank deposits available to respond to loan shocks during periods of market stress. Absent the recent innovation of sweep deposits

[31] Note that our point is not a critique per se of Lin's (2020) work, rather an extension in some ways. We also note that many of his other results, such as the focus on total domestic deposits and link to loans, are robust to our analysis.

[32] See, for instance, Diamond (1984) for theoretical arguments as to why intermediaries such as banks should make loans, and Gorton and Pennacchi (1992) for why intermediaries are valuable in the creation of demand deposits. But neither paper makes the point that an intermediary should provide both services.

[33] "Coronavirus-related Revolving Credit Drawdowns Grow to $222B via 414 Issuers," S&P Global Market Intelligence, April 14, 2020.

Electronic copy available at: https://ssrn.com/abstract=3690525

swept from brokerage firms to banks, client cash would reside on the balance sheets of brokerage firms and invested in short-dated Treasuries and comparable low-risk securities.

5. Do sweep deposits stabilize or destabilize banks?

The empirical analyses indicate that sweep deposits covary negatively with the stock market. Retail investors tend to run to the bank that takes the form of deposit inflows realized via stock sales when equity markets experience market downturns. In this section, we study the impact of sweep deposits on the stability of overall bank deposits. As we noted in the Introduction, some regulators have expressed concerns that brokered deposits, of which sweep deposits are a major component, destabilize banks due to their third-party structure. However, based on the research findings in the prior section, our conjecture is that sweep deposits are not destabilizing, but instead stabilizing for banks given the evidence that investors reduce risk by converting stock to cash during periods of high stress.[34]

Our exploration of the impact of sweep deposits on the variability of bank deposits begins with the comparison of standard deviations and coefficients of variations across various deposit measures. Panel A of Table 8 displays these volatility estimates for the periods examined earlier, 1984-2020 and 2000-2020, for the aggregate growth rate measures calculated quarterly and converted to annual estimates. Panel B reports a comparison of the bootstrapped ratios of standard deviations and coefficients of variations for the different types of deposit growth, indicating whether certain types of brokered deposits contribute to stabilizing or destabilizing overall bank deposits. Our discussion focuses on the more recent 20-year sample period since sweep deposits were not economically large enough to influence the variability of total deposits before 2000.

During 2000-2020, total deposits grew 6.53% annually with a standard deviation of 2.64%. In comparison to other claims on corporate assets, such as equity and debt securities, the 2.64% standard deviation for bank deposits is low. As Hanson, Shleifer, Stein, and Vishny (2015) explain, with a combination of a costly equity cushion, deposit insurance and other government protections, bank deposits in their words can "remain sleepy" and ignore the volatility of the underlying assets,

[34] The context is relevant here. As mentioned in the Introduction, Charles Schwab issued new securities to provide balance sheet funding for its strong deposit growth during the first quarter of 2020 when COVID-19 resulted in extremely high volatility. Thus, a bank which is obligated to accept sweep deposits might not view extraordinarily high growth as stabilizing, especially if it has relatively little capital beyond its capital requirements and therefore is forced to quickly issue new securities to provide sufficient equity capital to support the deposit growth.

Electronic copy available at: https://ssrn.com/abstract=3690525

hence the low volatility for deposit liabilities. In contrast to total deposits, Panel A in Table 8 illustrates that brokered deposits, including both sweep deposits and non-sweep brokered deposits, exhibit far higher levels of volatility. For example, the annual volatility of sweep deposits during 2000-2020 is 15.85%, six times higher than for total deposits volatility. Similarly, the average growth rate of 16.09% for sweep deposits is much higher than for total deposits.

An important feature of brokered deposits in general, and sweep deposits, specifically, is that these non-traditional deposit types not only provide additional funding growth for banks but also provide uncorrelated funding growth. For example, the correlation coefficient between the growth rate of brokered deposits and non-brokered deposits is 0.021 during 2000-2020, and the correlation is -0.024 between sweep deposits and non-brokered deposits over the same period. The low correlations have the effect of reducing the overall deposit growth rate variability. Notwithstanding their far higher volatility, the addition of brokered deposits, with a standard deviation of 11.09%, to non-brokered deposits, with a standard deviation of 2.67%, results in a modest decrease in the annual standard deviation of total domestic deposits (i.e., combined non-brokered deposits and brokered deposits) to 2.64%, as shown in Panel A of Table 8.

This variability decrease does not occur with both types of brokered deposits we study. That is, the addition of sweep deposits to non-brokered deposits is associated with a decrease in volatility for the latter from 2.67% to 2.60% for the resulting combination. In contrast, the addition of non-sweep brokered deposits is associated with a volatility increase from 2.67% for non-brokered deposits to 2.74% for this combination. The differential impact on the variability of total deposit growth is a result of the difference in correlations. We noted above that the correlation between the growth rate of sweep deposits and non-brokered deposits is -0.024. However, the correlation between non-sweep brokered deposits and non-brokered deposits is 0.132, and thus the high volatility of non-sweep brokered deposits outweighs its correlation benefits. Similar results apply when measuring volatility by the coefficient of variation rather than the standard deviation.

Panel B of Table 8 displays the results of bootstrapped distributions to assess the statistical significance of the impact of sweep deposits and other brokered deposits on the volatility of bank deposit growth rates. Specifically, we examine the separate effect on the volatility of adding sweep deposits, non-sweep brokered deposits, and brokered deposits to non-brokered deposits via computing the ratio of the volatility of the inclusive deposits sample to that of the non-brokered

Electronic copy available at: https://ssrn.com/abstract=3690525

deposits sample. For each ratio comparison, we compute 100,000 bootstrap results, as we describe below for the ratios of the volatilities of the different combinations of deposits, displayed in the first row of Panel B.

As discussed earlier, we analyze 81 quarterly observations during 2000-2020 and 144 observations during 1984-2020. For the 2000-2020 sample, we draw a single observation for a particular type of deposit growth rate at random. Then with replacement, we repeat the process until we have 81 observations as for the original sample. We then calculate the standard deviation and the coefficient of variation for the bootstrap sample of 81 observations. The final step is to repeat the process 99,999 times, which yields a bootstrapped distribution of 100,000 samples with estimates of the standard deviation and coefficient of variation, respectively.

The ratio of the standard deviation of total domestic deposits to that of non-brokered deposits for the bootstrapped distribution is less than one, or 0.988, for the 2000-2020 sample period. Thus, the addition of brokered deposits reduces the volatility of total deposit growth rates by 1.2%, and this decrease is not statistically different from zero. For the coefficient of variation, the ratio of the coefficient of variation of total domestic deposits to that of non-brokered deposits is 0.945; thus a 5.5% decrease that is significant at the 0.10 level. For the full sample period (1984-2020), the results are comparable, that is, an insignificant reduction in the ratio of the standard deviation of total domestic deposits to that of non-brokered deposits and a significant reduction in the coefficient of variation for the same ratios. Regulators have historically been concerned about the lack of stability of brokered deposits as a funding source. However, our evidence does not indicate an increase in overall deposit volatility due to the addition of brokered deposits insofar as the volatility ratios are not significantly greater than one.

As we noted above, the bifurcation of brokered deposits into sweep deposits versus non-sweep brokered deposits illuminates the differential impacts these two funding sources have on overall bank deposit volatility. As before, our focus is on the 2000-2020 period since 2000 is when sweep deposits began to become more relevant in deposit funding. The ratio of the standard deviation of non-brokered deposits with the inclusion of sweep deposits to that of non-brokered deposits is 0.972. Thus, the addition of sweep deposits reduces the volatility of the growth rate of non-brokered deposits by 2.8%, and is significant at the 0.10 level. While the 2.8% decrease in deposit volatility is not large in magnitude, it is important to point out that the proportion of sweep

Electronic copy available at: https://ssrn.com/abstract=3690525

deposits to non-brokered deposits over the 2000-2020 period is only 4.48%. And for the full sample period, the ratio is even less at 2.86%, thus consistent with the smaller reduction in volatility over the longer period when adding sweep deposits to non-brokered deposits. However, as we noted earlier, sweep deposits are underestimated by a magnitude of up to two due to the exclusion of sweep deposits by qualified affiliates from the calculation of brokered deposits. Since we expect qualified sweep deposits to behave similarly to non-qualified sweep deposits, it is our view that if we were able to account for the qualified sweep deposits, the resulting decrease in overall deposit variability would be even greater and at higher statistical significance.

The ratio of the coefficient of variation of total domestic deposits excluding non-sweep deposits to that of non-brokered deposits is 0.941. Thus, the inclusion of sweep deposits reduces the coefficient of variation by 5.9% percentage points and is highly significantly different from zero. Moreover, the reduction of the coefficient of variation is due not only to a reduction in volatility, but also due to an increase in the resulting growth rate. Even though the standard deviation of the growth rate of sweep deposits is several times higher than that for non-brokered deposits, the negative correlation, as we pointed out earlier, results in reducing the standard deviation of total domestic deposits.

A different picture emerges for non-sweep brokered deposits. For the 2000-2020 period, the ratio of the standard deviation of non-brokered deposits with the inclusion of non-sweep brokered deposits to that of non-brokered deposits is 1.026. Thus, these brokered deposits are destabilizing, at least in the sense of increasing the volatility of total deposits, although the ratio is not statistically significantly greater than one. Likewise, the inclusion of non-sweep brokered deposits also increases the ratio of coefficients of variations: the ratio is 1.012 and again not significantly greater than one.

While the policy focus historically has been on brokered deposits in aggregate, these results suggest there are notable differences between the impact of sweep deposits versus non-sweep brokered deposits on the overall volatility of bank deposits as a funding source. While sweep deposits, as also other brokered deposits, face higher regulatory capital charges than non-brokered deposits, these results imply they should be treated differently, and perhaps that sweep deposits should be treated the same as non-brokered deposits especially due to their correlation benefits.

Electronic copy available at: https://ssrn.com/abstract=3690525

6. Concluding remarks

The stock market has experienced numerous significant downturns, with one of the most significant and recent declines occurring in early 2020 due to the COVID-19 pandemic. When these disruptive events occur, retail investors reduce risk and sell stocks, with the proceeds channeled to safer investments, including bank deposits. As far as we are aware, there has been no study of the role of brokerage firms in serving as intermediaries in channeling funds from stock investors to banks at times when financial markets are under stress. The primary reason for this gap in the banking literature is due to a lack of data. However, despite the lack of publicly available information, we have gained access to actual data on sweep deposits for TD Ameritrade and its affiliated banks. Also, we obtain estimates of sweep deposits data for every bank from IDC.

Our empirical analysis uncovers a robust and negative relation between stock market returns and sweep deposits of customers at TD Ameritrade. More specifically, based on piecewise linear regression results, we find that sweep deposits growth at program banks of TD Ameritrade is significantly related to stock returns when they are negative, but not when the stock returns are positive. This finding indicates that there is an asymmetric relationship between sweep deposits growth and stock returns. We view this result as consistent with the "run to the bank" thesis; that is, as stock markets drop, brokerage customers reduce exposure to risky assets and thereby raise cash, which in turn is swept to banks.

When using aggregate bank data, we also find a significant inverse relationship between stock market returns and aggregate cash sweeps. Indeed, the stock-return coefficients for the sweep deposits results are over six times that for the total deposits results. Intuitively, to the extent that investors reduce exposure to the stock market during stress periods, the reduction will be magnified as regards sweep deposits due to their origin, namely, brokerage accounts. Overall, the results suggest that sweep deposits are a primary driver behind the relation between total deposits and stock market activity.

In addition, while regulators have been concerned for several decades about the lack of stability of brokered deposits as a funding source, we find that brokered deposits do not increase the overall deposit volatility. Importantly, our results suggest there are notable differences between the impact of sweep deposits versus non-sweep brokered deposits on the overall volatility of bank

Electronic copy available at: https://ssrn.com/abstract=3690525

deposits as a funding source. Indeed, despite their high volatility, the addition of sweep deposits appears to stabilize rather than destabilize non-brokered deposits. Thus, from a policy standpoint, this finding suggests that sweep deposits should not be treated negatively by regulators relative to non-brokered deposits.[35]

The innovation of bank sweeps not only provides a growing and diversified funding source for banks, but critically, during periods where banks are subject to bank runs by borrowers looking to drawn down their lines of credit. It would be interesting to see on a cross-sectional basis whether banks with relatively high exposures to credit line drawdowns are more likely to use brokered deposits, and in particular sweep deposits, as an alternative funding source.

While the focus has been on the impact of funds flowing from brokerage firms to banks via sweep deposits, the empirical results suggest further investigation into the behavioral aspects of the flows might be fruitful. One question is why do households appear to be net sellers of stocks during severe market downturns? A simple risk-based explanation would be that households target a constant risk portfolio and thus seek to rebalance in part from stocks to deposits when equity risk increases. But the question that then arisies is why would households target a constant risk portfolio? Alternatively, a common story in the financial press is that households often tend to flee the stock market sub-optimally when expected returns increase. In this case, institutions and/or the underlying corporate issuers opportunistically increase market exposure during these stress periods. The bottom line is that a better understanding of the reallocation of securities around market downturns arguably will yield greater insight into investor behavior.[36]

[35] Indeed, in conversations with senior executives of banks that are obligated to accept sweep deposits, they actually view the run to the bank as a risk if forced to substantially increase equity capital to fund the additional deposits, especially if forced to do so at an inopportune time of high market uncertainty. We note that the regulators appreciated this concern during the COVID-19 crisis and relaxed lending limits, capital, and liquidity rules, including community bank leverage ratios, supplementary leverage ratios (SLRs), capital and liquidity buffers and total loss absorbing capacity (TLAC). Also, the FDIC issued temporary interpretive relief allowing brokerage account sweep deposits to average up to 25% of securities account balances (rather than 10% as previously required) without counting as "brokered deposits" as well as a process for fast determination on the status of deposit arrangements under the "primary purpose" test for deposits intermediated through third party agents (Arnold & Porter, 2020).

[36] In this regard, see Hirshleifer (2015), for an excellent discussion of the importance of behavioral finance and the need to move to social finance to better understand how financial decisions form and spread.

Electronic copy available at: https://ssrn.com/abstract=3690525

References

Abrams, E. (2020). Assessing bank deposit market power given limited consumer consideration. Also available at SSRN 3431374.

Acharya, V. V., & Mora, N. (2015). A crisis of banks as liquidity providers. *The Journal of Finance*, *70*(1), 1-43.

Arnold & Porter. (2020). Executive order on regulatory relief issued to support economic recovery, June 4. https://www.arnoldporter.com/en/perspectives/publications/2020/06/eo-on-regulatory-relief-to-support-recovery.

Barth, J. R., & Sun, Y. (2018). Bank funding sources: A new look at brokered deposits. Utah center for financial services. David Eccles School of Business. University of Utah. January. Also available at SSRN 3186872.

Business Wire. (2015). Ameritrade to acquire TD Waterhouse U.S.A.; Expects annualized gross synergies of $578 million; Six dollars per share dividend for Ameritrade shareholders. June 22. https://www.businesswire.com/news/home/20050622005676/en/Ameritrade-Acquire-TD-Waterhouse-U.S.A.-Expects-Annualized

Clark, P. T. (2012). Just passing through: A history and critical analysis of FDIC insurance of deposits held by brokers and other custodians. *Review of Banking & Financial Law*, *32*, 99-178.

Clark, P. T. (2016). Comment to Regulatory Publication and Review Under the Economic Growth and Regulatory Paperwork Reduction Act of 1996: 12 U.S.C. § 183lf and 12 C.F.R. § 337.6 (Brokered Deposits). Seward & Kissel LLP. March 22.

Clark, P. T. (2019). Comment to brokered deposits and interest rate restrictions comments on advance notice of proposed rulemaking RIN 3064-AE94. Seward & Kissel LLP. May 5.

Drechsler, I., Savov, A., & Schnabl, P. (2017). The deposits channel of monetary policy. *The Quarterly Journal of Economics*, *132*(4), 1819-1876.

Federal Deposit Insurance Corporation and Federal Home Loan Bank Board. (1983). Advance notice of proposed rulemaking. Federal Register, 48(212). November 1. https://cdn.loc.gov/service/ll/fedreg/fr048/fr048212/fr048212.pdf .

Federal Deposit Insurance Corporation and Federal Home Loan Bank Board. (1984). Brokered deposits; Limitations on deposit insurance. Federal Register, 49(64). April 2. https://cdn.loc.gov/service/ll/fedreg/fr049/fr049064/fr049064.pdf

Federal Deposit Insurance Corporation. (2005). Are funds held in "Cash Management Accounts" viewed as brokered deposits by the FDIC? February 3. https://www.fdic.gov/regulations/laws/rules/4000-10350.html

Federal Deposit Insurance Corporation. (2011). Study on core deposits and brokered deposits. Submitted to Congress pursuant to the Dodd-Frank Wall Street Reform and Consumer Protection Act. June. www.fdic.gov/regulations/reform/coredeposit-study.pdf.

Electronic copy available at: https://ssrn.com/abstract=3690525

Federal Deposit Insurance Corporation. (2016). Guidance on identifying, accepting, and reporting brokered deposits frequently asked questions. June 30. www.fdic.gov/news/news/financial/2016/fil16042b.pdf.

Federal Deposit Insurance Corporation. (2017). Crisis and Response: An FDIC History, 2008 – 2013, December.

Federal Deposit Insurance Corporation. (2019). Unsafe and unsound banking practices: Brokered deposits and interest rate restrictions. Federal Register, 84(25). February 6. https://www.govinfo.gov/content/pkg/FR-2019-02-06/pdf/2018-28273.pdf

Fitch. (2020). Fitch rates Schwab's senior unsecured notes 'A'; Outlook stable. Bloomberg, March 24.

Fonda, D. (2019). How brokerages use 'sweep accounts' and cash in on your desire for convenience. *Barron's*, 1/4. https://www.barrons.com/articles/brokerage-sweep-accounts-51565986278.

Gatev, E., & Strahan, P. E. (2006). Banks' advantage in hedging liquidity risk: Theory and evidence from the commercial paper market. *The Journal of Finance*, *61*(2), 867-892.

Gatev, E., Schuermann, T., & Strahan, P. E. (2009). Managing bank liquidity risk: How deposit-loan synergies vary with market conditions. *The Review of Financial Studies*, *22*(3), 995-1020.

Gomez, M., Landier, A., Sraer, D., & Thesmar, D. (2020). Banks' exposure to interest rate risk and the transmission of monetary policy. *Journal of Monetary Economics*, forthcoming.

Government Publishing Office. (2012). *Code of Federal Regulations*. 12 CFR Ch. III (1-1-12 Edition). www.gpo.gov/fdsys/pkg/CFR-2012-title12-vol5/pdf/CFR-2012-title12-vol5-sec327-8.pdf.

Hamilton, W. (2005). Brokers shifting 'sweep' money. *Los Angeles Times*, August 1. https://www.latimes.com/archives/la-xpm-2005-aug-01-fi-broker1-story.html.

Hanson, S., Shleifer, A., Stein, J., & Vishny, R. (2015). Banks as patient fixed-income investors. *Journal of Financial Economics*, 117 (3), 449-469.

Harless, C. T. (1984). Brokered deposits: Issues and alternatives. Federal Reserve Bank of Atlanta, *Economic Review*. https://fraser.stlouisfed.org/files/docs/publications/frbatlreview/pages/66677_1980-1984.pdf.

Hirshleifer, D. (2015). Behavioral finance. *Annual Review of Financial Economics*, 7, 133-159.

Ivashina, V., & Scharfstein, D. (2010). Bank lending during the financial crisis of 2008. *Journal of Financial Economics*, *97*(3), 319-338.

Kashyap, A. K., & Stein, J. C. (2000). What do a million observations on banks say about the transmission of monetary policy?. *American Economic Review*, *90*(3), 407-428.

Kashyap, A. K., Rajan, R., & Stein, J. C. (2002). Banks as liquidity providers: An explanation for the coexistence of lending and deposit-taking. *The Journal of Finance*, *57*(1), 33-73.

Electronic copy available at: https://ssrn.com/abstract=3690525

Li, W., Ma, Y., & Zhao, Y. (2019). The passthrough of treasury supply to bank deposit funding. Columbia Business School, January 9.

Lin, L. (2020). Bank deposits and the stock market. *Review of Financial Studies,*33(6), 2622-2658.

Machlup, F. (1940). Bank deposits and the stock market in the cycle. *The American Economic Review, 30*(1), 83-91.

Pennacchi, G. (2006). Deposit insurance, bank regulation, and financial system risks. *Journal of Monetary Economics, 53*(1), 1-30.

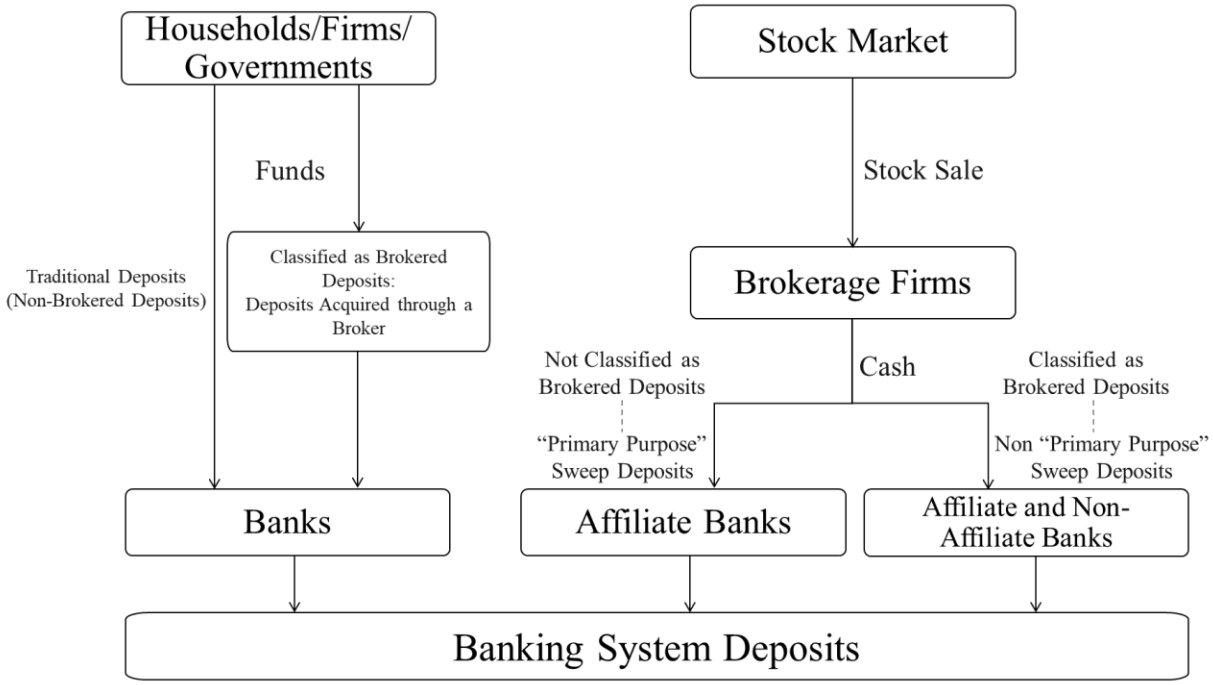
Seward, G. C. and R. M. Zaitzeff. (1984). Insurability of brokered deposits: A legislative analysis. *The Business Lawyer*, 39(4), 1705-1718.

Tepe, G. (2016). Broker-Dealer Use of Idle Customer Assets: Customer Protection with Sweep Programs and Securities Lending. *Columbia Business Law Review*, 2016, 823-876.

Electronic copy available at: https://ssrn.com/abstract=3690525

Figure 1. Traditional deposits, brokered deposits and sweep deposits

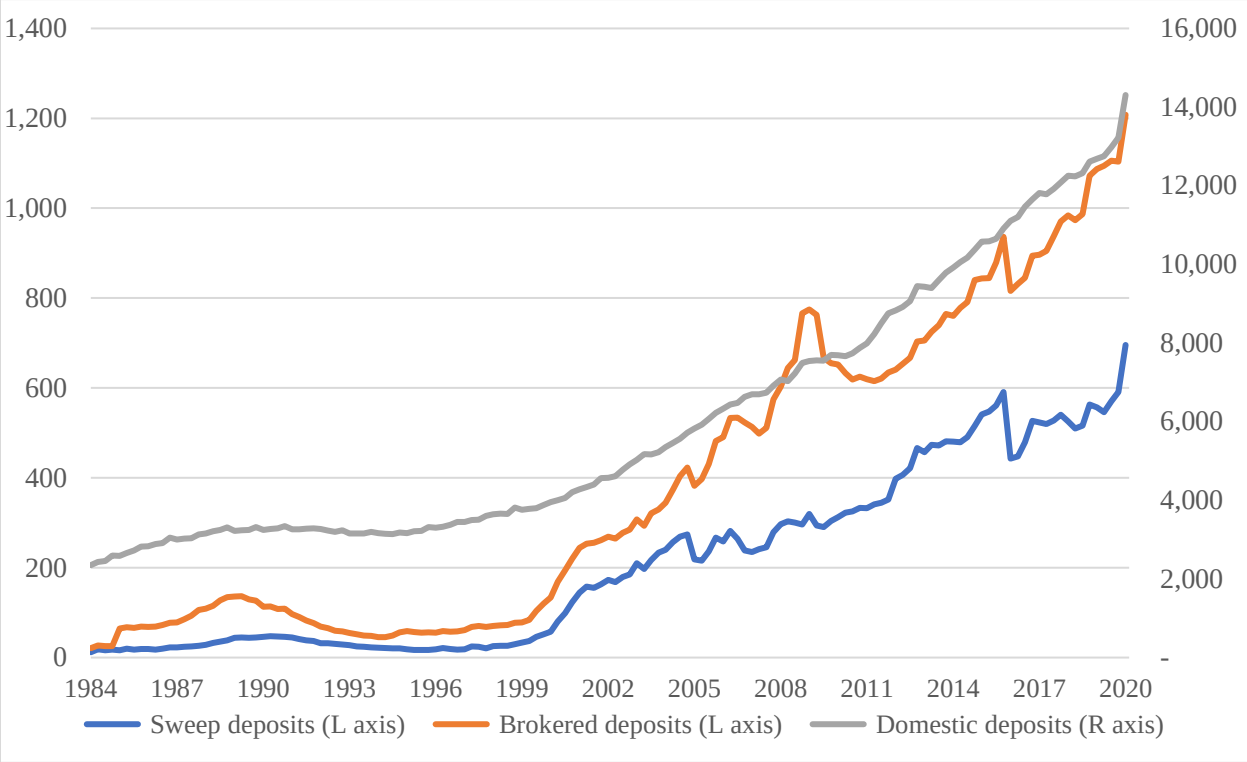
This chart shows the relationship between traditional deposits (non-brokered deposits), brokered deposits and sweep deposits.



Electronic copy available at: https://ssrn.com/abstract=3690525

Figure 2. Domestic deposits, brokered deposits and sweep deposits ($ billions)

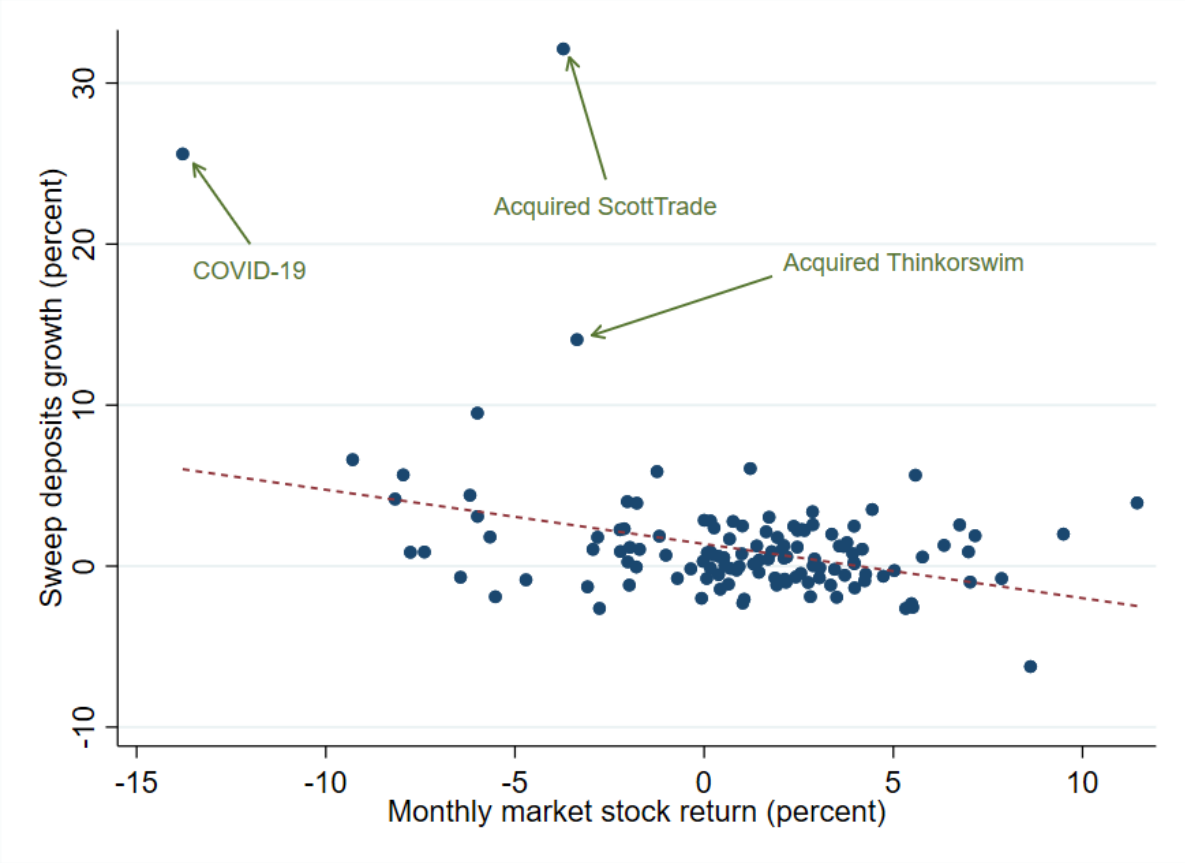
This figure plots the amount of bank domestic deposits and brokered deposits from FDIC and estimated sweep deposits from IDC during the period 1984Q1 to 2020Q1.



Electronic copy available at: https://ssrn.com/abstract=3690525

Figure 3. Liner relationship between sweeps deposits growth and monthly market stock returns

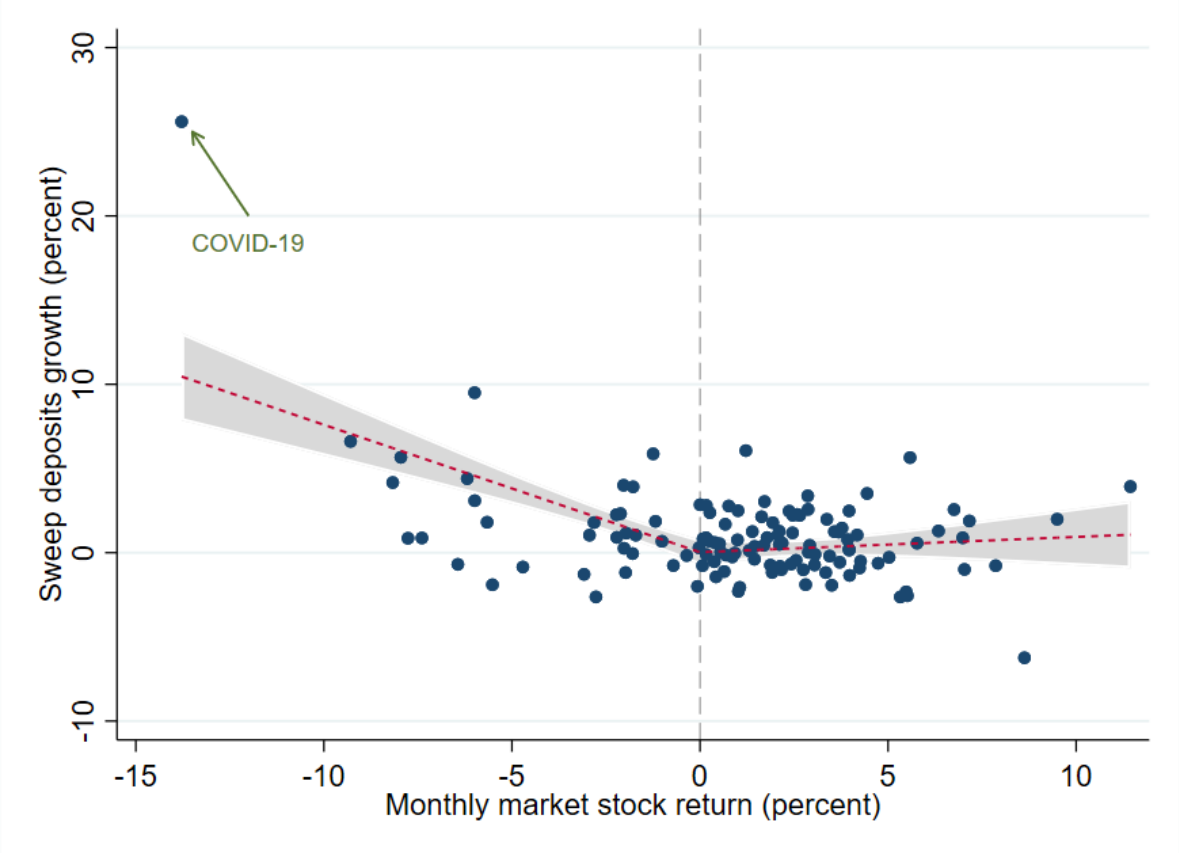
This figure plots monthly sweeps deposit growth arranged by TD Ameritrade against the monthly stock returns, for the period November 2009 to March 2020. The sweeps data is provided by TD Ameritrade and the market stock returns are from CRSP. The three observations with high sweeps growth rates occur when TD acquired Thinkorwim in January 2010, acquired ScottTrade in February 2018, which are excluded from the regression, and the COVID-19 outbreak in March 2020, respectively.



Electronic copy available at: https://ssrn.com/abstract=3690525

Figure 4. Piecewise linear relationship between sweeps deposits growth and monthly market stock returns

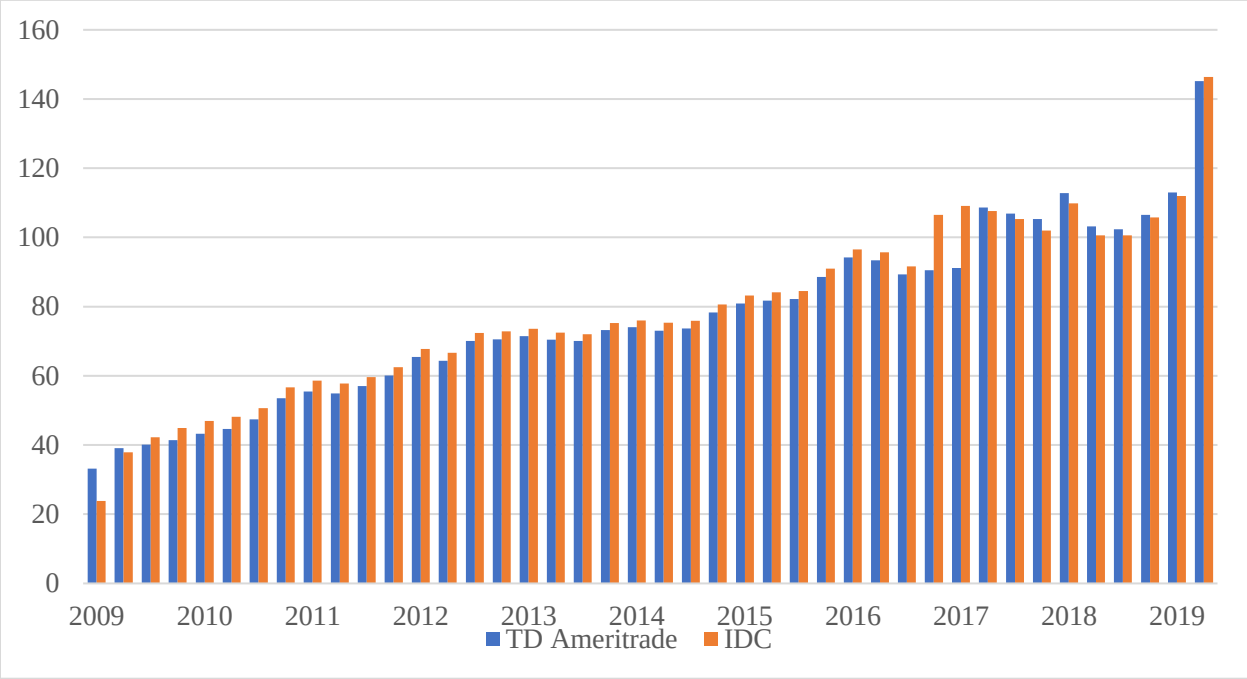
This figure describes the asymmetric relationship between sweep deposits growth and stock return using TD Ameritrade sweep data for the period November 2009 to March 2020. We plot the results using a piecewise regression, with zero stock return as the breakpoint. The slope is -0.757 (significantly different from 0) when the market return is negative and 0.091 (not significantly different from 0) when the market return is positive. The gray area indicates a 95 percent confidence interval. The results are essentially unchanged when omitting the COVID-19 month.



Electronic copy available at: https://ssrn.com/abstract=3690525

Figure 5. TD Ameritrade data and IDC data ($ billions)

This figure plots the quarterly amount of sweep deposits using TD Ameritrade brokerage data and IDC estimated data during the period 2009Q4 to 2020Q1. The blue bars represent the data that TD Ameritrade's cash sweeps into TD Banks, and orange bars represent the estimated data for two bank charters, TD Bank and TD Bank USA, by IDC.



Electronic copy available at: https://ssrn.com/abstract=3690525

Table 1. Brokered deposits and sweep deposits as of March 31, 2020

This table describes the distribution of domestic deposits, brokered deposits and sweep deposits among banks in different asset size groups. The table provides information of total number of banks, the total amount of domestic deposits of banks, number of banks with brokered deposits, the total brokered deposits held by those banks, the number of banks with sweep deposits, and the amount of sweep deposits held by those banks. The number of banks, domestic deposits and brokered deposits data are from Call Reports and sweep deposits data are from IDC.

Asset size group	Number of banks	Domestic deposits ($ billions)	Share of total domestic deposits (%)	Number of banks with brokered deposits	Brokered deposits ($ billions)	Share of total brokered deposits (%)	Number of banks with sweep deposits	Sweep deposits ($ billions)	Share of total sweep deposits (%)
Under $1 Billion	4,293	941	6.6	1,432	25	2.1	916	8	1.2
$1–10 Billion	685	1,455	10.1	424	91	7.5	333	35	5.0
$10–50 Billion	101	1,688	11.8	86	148	12.3	81	69	9.9
Over $50 Billion	46	10,266	71.5	44	944	78.1	42	583	83.9
All Banks	5,125	14,350	100.0	1,986	1,208	100	1,372	696	100

Electronic copy available at: https://ssrn.com/abstract=3690525

Table 2. Summary statistics

This table provides summary statistics for the time series data. Panel A reports the data for the period 1984Q2 to 2020Q1, Panel B reports the data for the period 2000Q1 to 2020Q1, and Panel C reports data for TD Ameritrade for the period November 2009 to March 2020. Deposit growth and brokered deposit growth are aggregate total domestic deposits and brokered deposits growth rates. Sweep deposits growth is aggregate sweep deposits provided by IDC in Panels A and B, while it is TD Ameritrade sweep deposits in Panel C. Stock returns are the returns of the value-weighted index from CRSP. GDP is the quarterly growth rate of GDP in Panels A and B, while it is the monthly growth rate from HIS Markit. The Federal Funds rate is the average monthly effective Federal Funds rate in the last month of a quarter and included in changes in Panels A and B, while it is the average monthly effective Federal Funds rate in changes in Panel C. HP growth is the quarterly growth rate of the U.S. residential housing price index (all-transactions Indexes and not seasonally adjusted) from the FHFA in Panels A and B, while it is the monthly change in Panel C.

Panel A. 1984Q2-2020Q1 (quarterly)

	Obs.	Mean	S.D.	Median	P2.5	P97.5	Min	Max
Domestic deposits growth	144	0.013	0.016	0.013	-0.022	0.045	-0.027	0.082
Brokered deposits growth	144	0.035	0.141	0.016	-0.110	0.237	-0.128	1.510
Sweep deposits growth	144	0.034	0.107	0.023	-0.141	0.310	-0.246	0.566
Stock return	144	0.029	0.084	0.039	-0.169	0.172	-0.232	0.218
GDP growth	144	0.006	0.006	0.007	-0.009	0.017	-0.022	0.018
Change in Fed Funds rate	144	-0.001	0.005	-0.000	-0.013	0.009	-0.029	0.011
HP growth	144	0.009	0.011	0.010	-0.026	0.028	-0.032	0.038

Panel B. 2000Q1-2020Q1 (quarterly)

	Obs.	Mean	S.D.	Median	P2.5	P97.5	Min	Max
Domestic deposits growth	81	0.016	0.013	0.016	-0.003	0.038	-0.006	0.082
Brokered deposits growth	81	0.030	0.058	0.021	-0.096	0.156	-0.128	0.260
Sweeps growth	81	0.040	0.093	0.024	-0.129	0.268	-0.246	0.460
Stock return	81	0.016	0.085	0.031	-0.169	0.159	-0.223	0.167
GDP growth	81	0.005	0.006	0.005	-0.011	0.014	-0.022	0.018
Change in Fed Funds rate	81	-0.001	0.005	0.000	-0.013	0.006	-0.017	0.007
HP growth	81	0.009	0.014	0.012	-0.026	0.030	-0.032	0.038

Panel C. TD Ameritrade, November 2009 to March 2020 (monthly)

	Obs.	Mean	S.D.	Median	Min	Max
Sweeps growth	125	0.014	0.043	0.007	-0.062	0.321
Stock return	125	0.010	0.040	0.014	-0.138	0.114
GDP growth	125	0.001	0.007	0.002	-0.054	0.017
Change in Fed Funds rate	125	0.000	0.001	0.000	-0.009	0.002
HP growth	125	0.003	0.007	0.002	-0.017	0.018

Electronic copy available at: https://ssrn.com/abstract=3690525

Table 3. TD Ameritrade tests: November 2009 to March 2020

This table presents the sweeps growth relationship to stock market returns for TD Ameritrade. Columns 2-4 remove two observations, one in January 2010 and the other in February 2018, when TD acquired Thinkorwim and ScottTrade, respectively. The dependent variable is monthly sweeps growth. the monthly stock returns are from the CRSP website; change in FF rate is the change in the monthly average of the effective Federal funds rate (not seasonally adjusted) from the Federal Reserve Bank of St. Louis; GDP growth is the monthly growth rate of GDP from the HIS Markit; and HP growth is the monthly growth rate of the residential housing purchase price index from the FHFA. Standard errors in parentheses, ***: p<0.01, **: p<0.05, *: p<0.10.

	(1)	(2)	(3)	(4)
	Sweeps growth	Sweeps growth	Sweeps growth	Sweeps growth
$Return_t$	-0.433***	-0.337***	-0.347***	-0.218***
	(0.089)	(0.064)	(0.063)	(0.056)
$Return_{t-1}$			-0.183***	-0.136**
			(0.066)	(0.056)
$GDP\ growth_t$				-1.189***
				(0.424)
$GDP\ growth_{t-1}$				-0.134
				(0.459)
$\Delta FFrate_t$				-9.548***
				(2.559)
$\Delta FFrate_{t-1}$				-7.832**
				(3.359)
$HP\ growth_t$				-0.621*
				(0.373)
$HP\ growth_{t-1}$				0.281
				(0.386)
Constant	0.018***	0.014***	0.016***	0.018***
	(0.004)	(0.003)	(0.003)	(0.003)
Coefficient sum			-0.530	-0.344
F-test (p-value)			0.0000	0.0000
N	125	123	123	123
R-squared	0.160	0.186	0.235	0.547

Electronic copy available at: https://ssrn.com/abstract=3690525

Table 4. Aggregate sweep deposits growth and stock market returns

The table shows estimates of the dependence of bank sweeps growth on stock market returns. The dependent variable is the quarterly growth of the aggregate bank sweep deposits, winsorized at the 2.5 percentile and 97.5 percentile to reduce the likelihood of random spurious outliers. The independent variables are the contemporaneous return of the value-weighted stock index from CRSP (Columns 1 and 4); contemporaneous and lagged return of the value-weighted stock index (Columns 2 and 5); contemporaneous, lagged stock return and GDP growth, change in Federal Funds rates, house price growth. Columns 1 to 3 cover the period 1984Q2 to 2020Q1, while Column 4 to 6 cover the period 2000Q1 to 2020Q1. The table also reports the coefficient sum of the contemporaneous and lagged stock return as well as the p-value for the F-test. Standard errors in parentheses, ***: p<0.01, **: p<0.05, *: p<0.10.

	(1) Sweeps growth	(2) Sweeps growth	(3) Sweeps growth	(4) Sweeps growth	(5) Sweeps growth	(6) Sweeps growth
$Return_t$	-0.162*	-0.167*	-0.252***	-0.239**	-0.238**	-0.305**
	(0.091)	(0.091)	(0.095)	(0.101)	(0.102)	(0.125)
$Return_{t-1}$		-0.123	-0.183*		-0.015	-0.088
		(0.093)	(0.095)		(0.103)	(0.128)
$GDP\ growth_t$			2.794*			2.641
			(1.565)			(1.986)
$GDP\ growth_{t-1}$			0.962			2.780
			(1.541)			(2.029)
$\Delta FFrate_t$			-0.810			-2.197
			(1.539)			(2.751)
$\Delta FFrate_{t-1}$			0.919			-1.569
			(1.531)			(2.759)
$HP\ growth_t$			0.086			-0.181
			(0.978)			(1.006)
$HP\ growth_{t-1}$			0.916			0.776
			(0.998)			(0.975)
Constant	0.037***	0.041***	0.011	0.044***	0.044***	0.013
	(0.008)	(0.009)	(0.015)	(0.009)	(0.009)	(0.015)
Coefficient sum		-0.290	-0.435		-0.253	-0.393
F-test (p-value)		0.0299	0.0025		0.0822	0.0428
N	144	144	144	81	81	81
R-squared	0.022	0.034	0.104	0.066	0.066	0.154

Electronic copy available at: https://ssrn.com/abstract=3690525

Table 5. Correlation table using aggregate data

Panel A. 1984Q2-2020Q1 (quarterly)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
$Sweeps\ growth_t$ (1)	1.000										
$Domestic\ deposits\ growth_t$ (2)	0.350***	1.000									
$Brokered\ deposits\ growth_t$ (3)	0.246***	0.722***	1.000								
$Return_t$ (4)	-0.204**	-0.196**	-0.145*	1.000							
$Return_{t-1}$ (5)	-0.158*	-0.124	-0.087	-0.041	1.000						
$GDP\ growth_t$ (6)	-0.166**	0.104	0.168**	0.289***	0.216***	1.000					
$GDP\ growth_{t-1}$ (7)	-0.023	0.146*	0.061	0.104	0.241***	0.360***	1.000				
$\Delta FFrate_t$ (8)	-0.177**	0.184**	0.086	0.070	0.095	0.374***	0.259***	1.000			
$\Delta FFrate_{t-1}$ (9)	0.040	0.047	0.057	0.156*	0.042	0.197**	0.355***	0.300***	1.000		
$HP\ growth_t$ (10)	0.075	0.174**	0.134	0.029	0.013	0.282***	0.277***	0.156*	0.141*	1.000	
$HP\ growth_{t-1}$ (11)	0.118	0.204**	0.149*	0.130	0.028	0.347***	0.292***	0.196**	0.156*	0.716***	1.000

Panel B. 2000Q1-2020Q1 (quarterly)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
$Sweeps\ growth_t$ (1)	1.000										
$Domestic\ deposits\ growth_t$ (2)	0.309***	1.000									
$Brokered\ deposits\ growth_t$ (3)	0.133	0.796***	1.000								
$Return_t$ (4)	-0.340***	-0.379***	-0.228**	1.000							
$Return_{t-1}$ (5)	-0.113	-0.115	-0.029	0.017	1.000						
$GDP\ growth_t$ (6)	-0.335***	-0.106	0.049	0.484***	0.241**	1.000					
$GDP\ growth_{t-1}$ (7)	-0.024	0.134	0.132	0.042	0.460***	0.289***	1.000				
$\Delta FFrate_t$ (8)	-0.251**	-0.102	-0.070	0.286***	0.313***	0.540***	0.303***	1.000			
$\Delta FFrate_{t-1}$ (9)	-0.009	0.027	-0.042	0.244**	0.242**	0.377***	0.503***	0.614***	1.000		
$HP\ growth_t$ (10)	0.094	0.240**	0.140	-0.040	-0.068	0.318***	0.346***	0.277**	0.278**	1.000	
$HP\ growth_{t-1}$ (11)	0.079	0.224**	0.125	0.169	-0.039	0.376***	0.330***	0.307***	0.283**	0.746***	1.000

Electronic copy available at: https://ssrn.com/abstract=3690525

Table 6. Regression results comparing TD brokerage firm data and IDC data

This table tests the relationship between quarterly sweeps growth and stock market returns for TD Ameritrade brokerage firm data (Panel A) and TD Bank data estimated by IDC data (Panel B). For comparison, we only include the period that we have data from both two sources, and, therefore, the period covered in the tests are from 2010Q1 to 2020Q1 (Column 1), Columns 2 to 4 remove two observations, 2010Q1 and 2018Q1, when TD acquired Thinkorwim and ScottTrade, respectively. The dependent variable is quarterly sweeps growth. the quarterly stock returns are from the CRSP website; change in FF rate is the change in the monthly average of the effective Federal Funds rate (not seasonally adjusted) in last month of each quarter; GDP growth is the quarterly growth rate of GDP from the Federal Reserve Bank of St. Louis; and HP growth is the quarterly growth rate of the residential housing price index from the FHFA. Standard errors in parentheses, ***: p<0.01, **: p<0.05, *: p<0.10.

Panel A. Using TD Ameritrade brokerage firm data

	(1) Sweeps growth	(2) Sweeps growth	(3) Sweeps growth	(4) Sweeps growth
$Return_t$	-0.484***	-0.488***	-0.489***	-0.312***
	(0.116)	(0.094)	(0.100)	(0.081)
$Return_{t-1}$			-0.003	-0.084
			(0.114)	(0.087)
$GDP\ growth_t$				-2.940**
				(1.380)
$GDP\ growth_{t-1}$				0.344
				(1.470)
$\Delta FFrate_t$				-0.896
				(4.706)
$\Delta FFrate_{t-1}$				-19.892***
				(6.742)
$HP\ growth_t$				-0.331
				(0.660)
$HP\ growth_{t-1}$				0.468
				(0.604)
Constant	0.053***	0.045***	0.045***	0.062***
	(0.009)	(0.008)	(0.009)	(0.012)
Coefficient sum			-0.492	-0.396
F-test (p-value)			0.0076	0.0062
N	41	39	39	39
R-squared	0.310	0.421	0.421	0.788

Electronic copy available at: https://ssrn.com/abstract=3690525

Panel B. Using TD Bank data

	(1) Sweeps growth	(2) Sweeps growth	(3) Sweeps growth	(4) Sweeps growth
$Return_t$	-0.446**	-0.538***	-0.546***	-0.451***
	(0.215)	(0.106)	(0.113)	(0.117)
$Return_{t-1}$			-0.030	-0.121
			(0.129)	(0.126)
$GDP\ growth_t$				-1.249
				(2.009)
$GDP\ growth_{t-1}$				0.287
				(2.140)
$\Delta FFrate_t$				-9.394
				(6.849)
$\Delta FFrate_{t-1}$				-6.800
				(9.812)
$HP\ growth_t$				-0.968
				(0.961)
$HP\ growth_{t-1}$				0.989
				(0.879)
Constant	0.063***	0.053***	0.054***	0.063***
	(0.017)	(0.009)	(0.010)	(0.018)
Coefficient sum			-0.576	-0.672
F-test (p-value)			0.0058	0.0066
N	41	39	39	39
R-squared	0.100	0.409	0.409	0.641

Electronic copy available at: https://ssrn.com/abstract=3690525

Table 7. Bank deposits and market returns

This table presents various types of bank deposits related to the stock market return. The dependent variable is quarterly aggregate domestic deposit growth in Columns 1 and 2; quarterly aggregate brokered deposit growth in Column 3 and 4, quarterly aggregate sweeps deposits growth in Column 5 and 6, non-brokered deposits (domestic deposits minus brokered deposits) growth in Column 7 and 8; and non-sweeps deposits (domestic deposits minus sweep deposits) growth in Column 9 and 10. To reduce the likelihood of random spurious outliers, we winsorized brokered deposits growth and sweep deposits growth at the 2.5 percentile and 97.5 percentile. Except for the sweep deposits, which obtained from IDC, other types of deposits are from Call Reports. The independent variables include contemporaneous and lagged quarterly returns of the value-weighted index from CRSP; Change in FFrate is the change in the effective Federal Funds rate (not seasonally adjusted) from the Federal Reserve Bank of St. Louis; GDP growth is the quarterly growth rate of the U.S. GDP from the Federal Reserve Bank of St. Louis and HP growth is the quarterly growth rate of the U.S. residential housing price index from the FHFA. Panel A presents the results using data from 1984Q2 to 2020Q1, and Panel B presents the results using data from 2000Q1 to 2020Q1. Standard errors in parentheses, ***: p<0.01, **: p<0.05, *: p<0.10.

Panel A. 1984Q2 – 2020Q1

	(1) Total deposits	(2) Total deposits	(3) Brokered deposits	(4) Brokered deposits	(5) Sweeps	(6) Sweeps	(7) Non-BD	(8) Non-BD	(9) Non-sweeps	(10) Non-sweeps
$Return_t$	-0.039**	-0.040**	-0.160**	-0.210***	-0.167*	-0.252***	-0.030*	-0.030*	-0.035**	-0.036**
	(0.015)	(0.016)	(0.065)	(0.066)	(0.091)	(0.095)	(0.015)	(0.016)	(0.015)	(0.016)
$Return_{t-1}$	-0.033**	-0.030*	-0.118*	-0.171**	-0.123	-0.183*	-0.026*	-0.021	-0.031**	-0.027*
	(0.015)	(0.016)	(0.067)	(0.067)	(0.093)	(0.095)	(0.016)	(0.016)	(0.016)	(0.016)
$GDP\ growth_t$		-0.290		0.747		2.794*		-0.265		-0.308
		(0.258)		(1.095)		(1.565)		(0.263)		(0.262)
$GDP\ growth_{t-1}$		0.142		1.893*		0.962		0.029		0.079
		(0.254)		(1.078)		(1.541)		(0.259)		(0.258)
$FFrate_t$		-0.568**		1.517		-0.810		-0.597**		-0.546**
		(0.253)		(1.076)		(1.539)		(0.258)		(0.258)
$\Delta FFrate_{t-1}$		0.347		-0.274		0.919		0.448*		0.388
		(0.252)		(1.071)		(1.531)		(0.257)		(0.257)
$HP\ growth_t$		-0.081		-0.087		0.086		-0.104		-0.088
		(0.161)		(0.684)		(0.978)		(0.164)		(0.164)
$HP\ growth_{t-1}$		0.334**		0.994		0.916		0.288*		0.327*
		(0.164)		(0.698)		(0.998)		(0.168)		(0.167)

Electronic copy available at: https://ssrn.com/abstract=3690525

Constant	0.015***	0.013***	0.034***	0.011	0.041***	0.011	0.014***	0.013***	0.014***	0.013***
	(0.001)	(0.002)	(0.006)	(0.010)	(0.009)	(0.015)	(0.001)	(0.002)	(0.001)	(0.002)
Coefficient sum	-0.072	-0.070	-0.278	-0.381	-0.290	-0.435	-0.056	-0.051	-0.066	-0.063
F-test (p-value)	0.0014	0.0033	0.0039	0.0002	0.0299	0.0025	0.0136	0.0303	0.0032	0.0084
N	144	144	144	144	144	144	144	144	144	144
R-squared	0.071	0.154	0.059	0.171	0.034	0.104	0.043	0.120	0.060	0.138

Panel B. 2000Q1 to 2020Q1

	(1) Total deposits	(2) Total deposits	(3) Brokered deposits	(4) Brokered deposits	(5) Sweeps	(6) Sweeps	(7) Non-BD	(8) Non-BD	(9) Non-sweeps	(10) Non-sweeps
$Return_t$	-0.052***	-0.038*	-0.245***	-0.289***	-0.238**	-0.305**	-0.037**	-0.021	-0.047***	-0.033
	(0.016)	(0.019)	(0.068)	(0.081)	(0.102)	(0.125)	(0.017)	(0.021)	(0.017)	(0.020)
$Return_{t-1}$	-0.017	0.004	-0.071	-0.100	-0.015	-0.088	-0.009	0.015	-0.016	0.008
	(0.017)	(0.020)	(0.069)	(0.084)	(0.103)	(0.128)	(0.017)	(0.021)	(0.018)	(0.021)
$GDP\ growth_t$		-0.538*		0.477		2.641		-0.555*		-0.610*
		(0.311)		(1.297)		(1.986)		(0.332)		(0.326)
$GDP\ growth_{t-1}$		-0.223		1.105		2.780		-0.360		-0.390
		(0.317)		(1.325)		(2.029)		(0.339)		(0.333)
$\Delta FFrate_t$		-0.815*		-1.596		-2.197		-0.743		-0.787*
		(0.430)		(1.796)		(2.751)		(0.460)		(0.452)
$\Delta FFrate_{t-1}$		0.853*		1.355		-1.569		0.876*		1.064**
		(0.432)		(1.802)		(2.759)		(0.462)		(0.453)
$HP\ growth_t$		0.018		-0.185		-0.181		0.033		0.023
		(0.157)		(0.657)		(1.006)		(0.168)		(0.165)
$HP\ growth_{t-1}$		0.223		1.106*		0.776		0.152		0.214
		(0.153)		(0.637)		(0.975)		(0.163)		(0.160)
Constant	0.018***	0.018***	0.036***	0.021**	0.044***	0.013	0.016***	0.018***	0.017***	0.019***
	(0.001)	(0.002)	(0.006)	(0.010)	(0.009)	(0.015)	(0.002)	(0.003)	(0.002)	(0.002)
Coefficient sum	-0.069	-0.034	-0.316	-0.389	-0.253	-0.393	-0.046	-0.006	-0.063	-0.025
F-test (p-value)	0.0037	0.2522	0.0014	0.0026	0.0822	0.0428	0.0650	0.8471	0.0106	0.4190
N	81	81	81	81	81	81	81	81	81	81
R-squared	0.127	0.254	0.155	0.263	0.066	0.154	0.058	0.166	0.099	0.235

Electronic copy available at: https://ssrn.com/abstract=3690525

Table 8. Volatility of deposits

Panel A of this table reports the average, standard deviation, and coefficient of variation for different types of deposit growth, including total domestic deposits, non-brokered deposits (total domestic deposits minus brokered deposits), brokered deposits, non-sweep brokered deposits (brokered deposits minus sweep deposits), total domestic deposits excluding sweep deposits (total domestic deposits minus sweep deposits), sweep deposits, and total domestic deposits excluding non-sweep brokered deposits (total domestic deposits minus non-sweep brokered deposits). The average, standard deviation, and coefficient of variation are annualized.

Panel B of this table reports a comparison of the ratios of standard deviations and coefficients of variations for different types of deposit growth using 100,000 bootstrap results. More specifically, each time we draw a single observation for a particular type of deposit growth rate at random, store it, put it back in the sample, and draw another observation, until we have the same number of observations as for the original sample. Then, we calculate the standard deviation and coefficient of variation for the different types of deposit growth. We repeat this process another 99,999 times. After completing this process, we compare the ratio of the standard deviation and coefficient of variation of two different types of deposit growth, which are reported along with the means of the ratios. The numbers reported in the parentheses are the percentage of ratios greater than one, indicating there is more variability in the numerator than the denominator.

Panel A

All banks	**1984Q2-2020Q1**			**2000Q1-2020Q1**		
	Mean	Standard deviation	Coefficient of variation	Mean	Standard deviation	Coefficient of variation
Total domestic deposits	5.10	3.11	0.61	6.53	2.64	0.40
Non-brokered deposits	4.87	3.11	0.64	6.24	2.67	0.43
Brokered deposits	10.21	13.36	1.31	12.24	11.09	0.91
Non-sweep brokered deposits	7.97	14.50	1.82	10.12	12.88	1.27
Sweep deposits	12.82	18.37	1.43	16.09	15.85	0.99
Total domestic deposits excluding sweep deposits	4.97	3.14	0.63	6.33	2.74	0.43
Total domestic deposits excluding non-sweep brokered deposits	5.00	3.10	0.62	6.45	2.60	0.40

Panel B

All banks (Ratios of standard deviations and coefficients of variations)	**1984Q2-2020Q1**		**2000Q1-2020Q1**	
	Standard deviation	Coefficient of variation	Standard deviation	Coefficient of variation
Total domestic deposits / Non-brokered deposits	0.999 (0.497)	0.956 (0.049)	0.988 (0.344)	0.945 (0.069)
Total domestic deposits excluding sweep deposits / Non-brokered deposits	1.008 (0.710)	0.989 (0.345)	1.026 (0.837)	1.012 (0.611)
Total domestic deposits excluding non-sweep deposits / Non-brokered deposits	0.995 (0.333)	0.969 (0.018)	0.972 (0.097)	0.941 (0.013)

Electronic copy available at: https://ssrn.com/abstract=3690525

Appendix: Origins, Definitions and Types of Brokered Deposits

1. Origins

Although our focus is mainly on sweep deposits, they are considered one type of brokered deposits. We therefore provide a general overview of brokered deposits, followed by a more detailed discussion of sweep deposits in the subsequent section. Brokered deposits first appeared in the early 1960s when institutional investors such as money market funds, corporations, bank trust departments, and insurance departments purchased, through deposit brokers, certificates of deposit (CDs) (Seward and Zaitzeff, 1984). The biggest banks were the first to acquire brokered CDs during this period and investors liked them because the rates offered on them weren't subject to regulatory interest rate restrictions in effect at the time (Harless, 1984, pp. 18-19). Regional banks followed suit in the mid-1970s, and small- and mid-size banks rarely turned to CDs until the late-1970s (Barth and Sun, 2018). In the early 1980s, individuals were also provided access, through deposit brokers, to CDs, and thereby could enjoy the same benefits of liquidity and competitive market rates that institutional investors enjoyed (Seward and Zaitzeff, 1984). To be more specific, according to Clark (2012), in 1980, The Depository Institutions Deregulation and Monetary Control Act de-regulated interest rates on deposit accounts and raised the insurance limit from $40,000 to $100,000. In response, he points out that brokerage firms such as Merrill Lynch, Dean Witter, Prudential Securities, and Shearson/American Express began offering bank CDs at market interest rates to their retail customers on the basis of the availability of FDIC pass-through insurance to customers up to the new limits.

Then, in 1999, the Gramm-Leach-Bliley Act (GLB), also known as the Financial Modernization Act, allowed banks, securities firms, and insurance companies to affiliate under a financial holding company. This allowed brokerage firms to sweep their customers' account balances from money market mutual funds into deposits at affiliated banks. Merrill Lynch was the first to change the default sweep of its Cash Management Account (CMA) from Merrill's CMA Money Fund into Money Market Deposit Accounts (MMDAs) at Merrill Lynch Bank USA or Merrill Lynch Bank & Trust (Pennacchi, 2006).

More generally, with the innovation of CDs, in particular, and the use of brokerage firms, in general, banks could raise funds from savers and investors well beyond their local service markets. There are more than 15 broker-dealers that act as lead underwriters for brokered CDs, with hundreds of others participating, according to Clark (2019). In short, technological and financial innovations have given thousands of banks access to a broader range of alternative funding sources than simply deposits obtained through a branch network.

2. Definitions

There has always been debate as to what exactly constitutes brokered deposits. The first official attempt to define the different types of these deposits appears in November 1983, when the Federal Home Loan Bank Board (FHLBB) and the FDIC described three forms of deposit brokering: (1) simple brokering, in which a money broker solicits deposits from customers for placement by the broker or by the customer at banks; (2) CD participations, in which a broker-dealer purchases a bank-issued CD and sells interests in the CD to customers; and (3) deposit-listing services, in which a bank advertises interest rates and maturities through a third party who arranges for the sale of the bank's deposits to the public (FDIC and FHLBB, 1983).

In January 1984, the FHLBB and the FDIC defined a "deposit broker" as any person or entity, other than an insured institution or its employees, engaged in the business of placing or listing for placement the deposits of insured institutions (FDIC and FHLBB, 1984). Five years later, in 1989, the Financial

Electronic copy available at: https://ssrn.com/abstract=3690525

Institutions Reform, Recovery, and Enforcement Act (FIRREA) defined a brokered deposit as any deposit obtained, directly or indirectly, from or through the mediation or assistance of a deposit broker, where the term "deposit broker" meant: (1) any person engaged in the business of placing deposits, or facilitating the placement of deposits, of third parties with insured depository institutions; or engaged in the business of placing deposits with insured depository institutions for the purpose of selling interests in those deposits to third parties; and (2) an agent or trustee who establishes a deposit account to facilitate a business arrangement with an insured depository institution to use the proceeds of the account to fund a prearranged loan (Barth and Sun, 2017).

More recently, in July 2016, the FDIC defined a brokered deposit to be "any deposit that is obtained, directly or indirectly, from or through the mediation or assistance of a deposit broker" (FDIC, 2016, p. 1). This definition is sufficiently broad that a brokered deposit may be any deposit accepted by an insured depository institution from or through a third party, such as a person or company or organization other than the owner of the deposit. The bottom line is that, as the FDIC (2019) states, "… the meaning of the term 'brokered deposit' turns upon the definition of 'deposit broker'."

3. Types

When FIRREA became a law in 1989, many banks didn't use, or barely used, deposit listing and placement services, sweep programs, reciprocal brokered deposits, and general purpose prepaid cards. However, these are all innovations in financial technology that are in use today. More importantly, subject to certain exceptions, some of them are considered brokered deposits.

3.1 Listing and placement services

A listing and placement service compiles and publishes information for potential depositors about the deposit accounts available from different banks. But not every such service is considered a deposit broker. "Where the only function of a deposit listing service is to provide information on the availability and terms of accounts," according to the FDIC, "we believe that the listing service is not facilitating the placement of deposits. Rather, it facilitates the decision of the would-be buyer whether (and from whom) to buy a certificate of deposit; it is not facilitating the placement of deposits per se [italics original]" (FDIC, 2016, p. 6). In this case, the listing service is not considered to be a deposit broker. Since 2011, such deposits have been reported on banks' Call Reports. As of the last quarter of 2019, insured depository institutions reported holding $80 billion in listing service deposits that are not reported as brokered deposits. As regards the amount of such deposits that are considered to be brokered deposits, it is reported that listing and placement service deposits typically are not brokered deposits (FDIC, 2019).

3.2 Sweep deposits

A brokerage firm may operate a sweep program in which its customers sweep, or transfer, their excess cash balances into a bank deposit that provides a positive return and insurance coverage on those funds (FDIC, 2011, p. 25). Although the FDIC generally considers any securities firm or investment company that places deposits in a bank to be a deposit broker, it made an exception on February 3, 2005 for a firm when the "primary purpose" of its program is to facilitate its clients' purchase and sale of securities, not to provide them with a deposit-placement service (FDIC, 2015). In making this determination, the FDIC relies on three factors: (1) the funds are not swept into time deposit accounts; (2) the amount of swept funds doesn't exceed 10 percent of the total amount of program assets handled by the brokerage firm on a monthly basis; and (3) the program fees are "flat" (i.e., equal "per account" or "per customer" fees, representing payment for recordkeeping or administrative services, and not representing payment for placing deposits) (FDIC, 2011, pp. 26−27). If these requirements are satisfied, the company is

Electronic copy available at: https://ssrn.com/abstract=3690525

not a deposit broker under the "primary purpose" exception with respect to the "swept" funds. If the requirements are not satisfied, the company is a deposit broker. It should be noted that some sweeps from affiliates do qualify for the "primary purpose" exception, while other sweeps from affiliates are considered by the FDIC to pose sufficient potential problems that they are treated as brokered deposits (FDIC, 2011, p.55).

3.3 Reciprocal deposits

A reciprocal deposit is one that "an insured depository institution receives through a deposit placement network on a reciprocal basis, such that: (1) for any deposit received, the institution (as agent for depositors) places the same amount with other insured depository institutions through the network; and (2) each member of the network sets the interest rate to be paid on the entire amount of funds it places with other network members" (Government Publishing Office, 2012). Promontory Interfinancial Network launched the reciprocal deposits in 2003. These deposits are almost all insured since they exist only to increase a depositor's insurance coverage. The FDIC considered these deposits to be brokered deposits. However, the Economic Growth, Regulatory Relief, and Consumer Protection Act of 2018, provides that most reciprocal deposits are no longer treated as brokered deposits. Banks began reporting reciprocal deposits in June 30, 2009 (FDIC, 2011, p. 117). As of the last quarter of 2019, reciprocal deposits amounted to $87 billion.

3.4 General-purpose prepaid cards

A general-purpose prepaid card is sold at retail stores or other public venues. After the funds are collected from the card purchaser, they may be deposited by the card company or other third party into a custodial account at an insured depository institution. The cardholder can then access the funds by using the card. The FDIC considers prepaid card companies or other third parties who sell these cards to be deposit brokers, and the deposits are classified as brokered deposits (FDIC, 2019).

Electronic copy available at: https://ssrn.com/abstract=3690525