Uniform Rate Setting and the Deposit Channel*

Juliane Begenau[†] Erik Stafford [‡]

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Abstract

US banks predominately use uniform deposit rate setting policies, particularly the largest banks. Uniform rate setting ignores local market concentration, and therefore, popular versions of the deposit channel relying on variation in a bank's local rate setting behavior do not operate among the majority of all branches. Early empirical support for the deposit channel excludes networked branches, representing over 90% of all branches. Our findings are robust to alternative measures of bank market power measures and definitions of local deposit markets. We also find evidence of substantial substitution in aggregate bank funding sources, which pushes against the notion that the largest banks are unable to manage deposit withdrawals. Several reliable relationships in the cross section of banks may not aggregate because of the extreme bank size distribution and the differential behavior of small and large banks.

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[†]Begenau: Stanford GSB and NBER and CEPR. E-mail: begenau@stanford.edu

[‡]Stafford: HBS. E-mail: estafford@hbs.edu

1 Introduction

Claims about the market power of bank deposits in the banking literature are numerous and far-reaching. Banks do not completely pass through changes in short-term market rates to depositors.[1] In the cross section of banks and bank branches, the degree of passthrough of market rates to deposit rates is found to be reliably related to the concentration of the local deposit market (Drechsler, Savov, and Schnabl, 2017). Specifically, following an increase in the monetary policy rate, banks appear to increase their deposit rates less completely (or more sluggishly) at branches located in more concentrated deposit markets. This cross-sectional relationship forms the basis for an emerging literature that causally links cross-sectional variation in bank market power to monetary policy,[2] relationship banking,[3] and banks' interest rate risk exposure.[4] The underlying empirical relation between local market concentration and banks' rate setting policies is appealing because it appears to be both well-identified and to aggregate across banks to create a monetary policy channel.

The deposit channel of monetary policy operates in three steps. First, deposit pricing power allows banks to imperfectly pass through market rate increases to deposit rates, which increases the opportunity costs of holding deposits for bank depositors. Second, the increased opportunity costs of holding deposits when the market rate increases, drive deposits out of the bank, and in aggregate, out of the banking system. Third, banks cannot perfectly offset the loss of deposit funding and consequently reduce lending.

Testing the deposit channel is inherently difficult because the predicted empirical relations may instead be due to other factors such as heterogeneous demand shocks.[5] Drechsler, Savov, and Schnabl (2017) develop a clever identification strategy to test the first-stage of the deposit channel.

[1]Early papers in the empirical literature examining the relation between deposit rates and market interest rates include Ausubel (1992); Berger and Hannan (1989); Diebold and Sharpe (1990); Hannan and Liang (1993); Hannan and Berger (1997); Neumark and Sharpe (1992).

[2]E.g., Drechsler, Savov, and Schnabl (2017); Wang (2018); Wang, Whited, Wu, and Xiao (2022); Choi and Rocheteau (2023)

[3]E.g., Granja, Leuz, and Rajan (2022)

[4]E.g., Hoffmann, Langfield, Pierobon, and Vuillemey (2019); Drechsler, Savov, and Schnabl (2021)

[5]E.g., Fratantoni and Schuh (2003); Auclert (2019); Beraja, Fuster, Hurst, and Vavra (2019)

A first identifying assumption is that the variation in the concentration of the local deposit market, county HHI, measures the variation in the deposit market power at the branch level. Second, they assume that a bank operating in multiple counties will optimally choose to increase deposit rates more sluggishly following an increase in the market rate in the more concentrated market, thus increasing the spread among branches operating in more concentrated counties relative to the spreads at branches in less concentrated counties. Finally, deposit demand sensitivities to monetary policy shocks are assumed to be sufficiently similar across a bank's customers within a state that state$\times$time fixed effects absorb relevant regional demand shocks. These assumptions imply that the variation in local market concentration only affects the deposit demand sensitivities through the optimal rate-setting policies of banks. This allows the within bank differential spread changes across counties, indexed by market concentration, to be used to measure the differential deposit flow sensitivities that are driven by the deposit channel mechanism (i.e. imperfect pass-through of the market rate to deposits). They find strong empirical support for the first-stage of the deposit channel and document empirical patterns in deposit flow sensitivities and loan growth sensitivities consistent with the deposit channel, which together provide compelling support.

Evidence presented in this paper suggests that the empirical support for the deposit channel of monetary policy is far weaker than previous studies suggest. Central to our findings is the widespread use of uniform deposit rate setting policies among US commercial banks. Uniform rate setting, if literally true, clearly violates the identification assumption that banks exploit variation in local deposit market concentration in their rate setting decisions. Consistent with recent evidence of uniform pricing in retail (DellaVigna and Gentzkow, 2019) and around bank acquisitions (Granja and Paixao, 2021), we find that large banks are especially likely to use uniform rate setting policies (see also earlier evidence in Radecki (1998) and Heitfield and Prager (2004)). For example, in 2007, Bank of America operated 5728 branches across 694 counties and 31 states, yet reported using only two different rates for retail money market accounts (see Panels B and C of Table 2) across all of its US branches. By construction, this centralized rate-setting policy does not exploit the variation in local deposit market concentration in the way assumed by the Drechsler, Savov, and Schnabl (2017) identification strategy. From the perspective of deposit market power theories, this is especially unexpected since a large bank like Bank of America, operating across many geographic regions, is relatively well-positioned to make use of the variation in market power in its deposit rate setting choices.

The heavy reliance on uniform deposit rate setting, especially among large banks, highlights an important research design choice in the early literature. In the main analysis of the first-stage of the deposit channel reported in Drechsler, Savov, and Schnabl (2017), all "follower" branches – branches whose deposit rates are determined by a centralized rate-setting policy – are excluded. This sample restriction eliminates over 90% of all US commercial bank branches. We find that when follower branches are included in the branch-level within bank-time regressions, there is no reliable relation between deposit rate pass-through and market concentration, which is at odds with the first stage of the deposit channel.

Clean identification of the first-stage of the deposit channel mechanism is important because the other predicted empirical relationships – slower deposit and loan growth in relatively concentrated deposit markets following an increase in the monetary policy rate – can also be caused by varying local demand conditions. We make use of the uniform rate setting behavior of commercial banks to assess the plausibility of demand factors being responsible for the observed empirical patterns. By definition, the first stage of deposit channel (localized price setting) does not operate through branches that are part of a centralized rate setting network. Therefore, the empirical relation predicted by the deposit channel for branch deposit growth should not be reliable among these branches. However, we find that the empirical relationship, i.e., slower branch level deposit growth in high HHI counties when the Federal Funds rate increases, is equally reliable in the sample of network branches as in the full sample of branches, indicating that something other than rate setting behavior by banks as assumed by the deposit channel is explaining the relationship.

Our first analysis characterizes the extent to which centralized rate setting is used by US commercial banks and the characteristics of the banks that utilize this policy. A bank that uses a centralized rate setting policy will have potentially several networks of branches, where all branches within the network use identical rates per deposit product. One of the branches in the network is considered the rate setting branch and the other branches in the network are its "followers." The uniform rate setting branch networks are largely based on geography, with 96% of follower branches operating within the same state as the associated rate setting branch. However, banks tend to set substantially fewer unique rates than their number of rate setting branches. We consider banks that operate branches in more than 15 counties to have a "large geographic reach." In 2007, there are 163 large reach banks that together have a 60% U.S. deposit market share. These banks operate 50,660 branches, or 311 branches per bank, and, on average, have 7 rate setting branches while setting fewer than 3 unique rates.

Our second analysis documents the consequences of including and excluding follower branches in the analysis of branch-level pass-through rates in relation to deposit market concentration. We begin by replicating the branch-level results in Drechsler, Savov, and Schnabl (2017), calculated as they do by excluding all follower branches. This analysis reliably confirms their results. We then repeat this analysis after including the follower branches. The inclusion of follower branches in the cross-sectional analysis reduces the regression coefficient on the primary variable, the interaction of the change in the Federal funds rate and county-level HHI,[6] to zero. This is important as it shows that the first-stage of the deposit channel mechanism is absent in the vast majority of branches.

We investigate whether our failure to detect evidence of the first stage of the deposit channel after considering all branches is due to the county-level market definition. We test the possibility that large banks strategically set their branch network deposit rates at a geographic level broader than county. Specifically, we redefine local deposit markets at the MSA or state level and conduct similar deposit spread analyses as before, using bank-by-local market offer rates. These analyses also fail to find evidence of the first-stage mechanism of the deposit channel.

Motivated by the observation that large banks are relatively likely to use uniform rate-setting policies, we explore the sensitivity of inferences about the aggregation of the various stages of the deposit channel of monetary policy. Drechsler, Savov, and Schnabl (2017) show that when deposit

[6]The primary deposit market concentration measure used in this literature is the Herfindahl-Hirschman index (HHI).

markets are more concentrated and the market interest rate increases, bank deposit *spreads* grow faster, bank-level deposit growth is slower, and loan growth is slower. Drechsler, Savov, and Schnabl (2017) interpret these estimates as demonstrating that the deposit channel explains the aggregate transmission of monetary policy through bank balance sheets, leaning on the first-stage result being well-identified to rule out local demand factors.

We show that when the sample is restricted to the largest banks accounting for 90% of aggregate bank assets, these empirical relations are unreliable, sometimes with the incorrect sign. In fact, among the large banks, the deposit growth relation is reliably *positive*. These results demonstrate that reliable empirical relations in the cross section of banks may be unreliable among the relatively few banks that account for virtually all of the deposit and loan dollars in the banking system.

Another possibility is that HHI is a poor market power measure and we find evidence to support this notion. Specifically, in cross sectional regressions of stock market valuation multiples on bank-HHI, we find that the stock market appears to value banks with a relatively high proportion of their branches operating in relatively concentrated deposit markets no higher than other banks. Consequently, we consider two additional measures of deposit market power that both have a positive relation to stock market valuation multiples. The first of these is the deposit productivity measure developed in Egan, Lewellen, and Sunderam (2022). The second market power measure is a rate-gap-deposit-flow index we construct based on the observation that for a bank using uniform rate setting there will be substantial variation in their branch rates relative to the county average rate due to the large cross-sectional variation in county rates. Thus, our index is based on the notion that banks with deposit pricing power may be able to offer low rates relative to the county rate, while maintaining average deposit growth.[7] Reexamining the bank-level deposit channel relations for spreads, deposit growth, and loan growth with these two additional measures of market power also fail to detect the predicted relationships.

Our final empirical analyses focus on the last step of the deposit channel, whereby banks facing deposit withdrawals or slower deposit growth, become financially constrained, and are therefore

[7] d'Avernas, Eisfeldt, Huang, Stanton, and Wallace (2023) also show that large banks pay less on their deposits.

forced to reduce lending. There are two related issues with this mechanism. First, not all deposits should be expected to contribute equally to a deposit channel. For example, non-interest bearing deposits are more likely to support payment requirements, having few alternatives outside the banking system, than to represent investments for the depositor. Similarly, time deposits offer rates that are fairly close to market rates (Fama, 1985), so these deposit balances are unlikely to share the same sensitivity to the monetary policy rate as other deposits. Second, for deposit withdrawals to create financial constraints, it must be the case that alternative funding sources like bank-issued debt are imperfect substitutes.

We conduct an analysis of aggregate deposit flow sensitivities to changes in the Federal funds rate and find a statistically weak relation. However, when deposits are decomposed into those likely to be part of a deposit channel (DC) and those that are not (notDC), we find a strong negative deposit flow sensitivity for DC deposits and a strong positive sensitivity for notDC deposits. Additionally, we find a strong positive sensitivity for non-deposit debt flows. These findings suggest that, in the aggregate, there is substantial substitutability among funding sources.[8]

2 Bank Data and Rate Setting Policies

2.1 Data Sources

Our analysis is based on several data sources: branch level deposit data from the FDIC Summary of Deposits (SOD), deposit offer rates from RateWatch, commercial bank call reports, bank holding company call reports, and market data from CRSP. Unlike the Summary of Deposit data from the FDIC or bank call reports, RateWatch is a commercial data set that needs to be purchased and is not publicly available.

FDIC Summary of Deposits. The "Summary of Deposits" (SOD) from the FDIC is an annual survey that collects information about the deposits held in branch offices of all FDIC-insured in-

[8]This is consistent with Whited, Wu, and Xiao (2022).

stitutions, including insured U.S. branches of foreign banks. This survey is conducted as of June 30, each year and covers commercial and savings banks. The SOD dataset provides a comprehensive listing of branch office locations and total deposits reported by these branches. We use this data to calculate the deposit concentration of the county (also zip, MSA, or state) deposit market (Herfindahl-Hirschman index (HHI)), as well as bank and county level deposit amounts.

RateWatch. The commercially available "RateWatch" dataset, now part of S&P Global Market Intelligence following its acquisition in 2018, is a frequently used source for bank interest rates data, primarily focusing on depository rates for U.S. banks and credit unions. RateWatch collects weekly deposit rates advertised to new deposit accounts for a range of standardized products (e.g. $25K money market account) at the branch-level.[9] The branch-level data includes the FDIC branch identifier (UNINUMBR) and the FDIC identifier of the commercial bank owner of the branch (CERT), as well as geographic details and the history of the branch's commercial bank owner (in a separate file).[10] We focus on the rate quotes from the last week of a given quarter to construct a quarterly dataset. Additionally, the RateWatch dataset identifies which branches are "rate setters," and which associated branches are "followers." The follower branches offer rates identical to their associated rate setting branch. The currently available RateWatch dataset begins in 2001, a few years later than the datasets used in earlier research.[11]

To calculate deposit spreads, we use the effective Federal funds rate (FFR) converted to a quarterly frequency based on the end of period observation. To compare to previous research we also use the Federal funds target rate. As the earlier literature, we focus on the most common deposit products: $25K money market accounts, and to somewhat less degree on $10K one year certificates of deposits.

[9] For example, in 2019 the deposit rate file includes 86.1 million observations, covering 9909 branches that were surveyed more frequently than weekly (55 times on average) on 8 broad product types.

[10] RateWatch's institution details file is from the time the data was obtained and thus needs to be combined with the FDIC cert history file to ensure that branches are matched to the correct commercial bank owner. Alternatively, one can use data from the FFIEC to track a branch's owernship through time.

[11] From an email discussion in November 2020, with RateWatch they noted the reason as follows: "our database team recently decided that due to inconsistencies in the amount of data we were collecting back in 1997-2000, that it would be best moving forward to only go back as far as 2001."

Linking the RateWatch data to the SOD data accurately back in time is not straightforward. We first start with a panel of all branches that existed during our sample period (2001-2019) using FDIC data. We then create a RateWatch and SOD link based on the information provided by RateWatch and update it with information from the FDIC on branch creation, closures, and ownership changes, verifying the accuracy of RateWatch's branch ownership file. When an SOD-RateWatch match cannot be established with the UNINUMBR and CERT, we attempt to match based on address. We then populate the panel with rates from rate setters based on RateWatch's link file of rate-setting branches to followers and deposits from the SOD. Thus, only RateWatch observations that can be verifiably linked to a branch will be used in our analysis. Section 2.2 discusses the properties of this match.

Bank Level Data. We obtain detailed bank-level data from quarterly regulatory filings of commercial banks collected in multiple forms, most recently forms FFIEC 031 and FFIEC 041. The quarterly bank data used for this analysis begin in 1985, but many important variables only become available in 1996.

In our analysis of stock market bank valuations, we rely on bank-level data from quarterly regulatory filings of bank holding companies (BHC) collected by the Federal Reserve in form FR Y-9C. We link each BHC to its commercial banks based on the BHC identifier (rssd9348) available in the commercial bank call reports. We use stock market data, including returns and market capitalization of publicly traded BHCs, from the Center for Research in Security Prices (CRSP). The Federal Reserve provides a table for linking the bank regulatory data with CRSP.

County Economic Data. We also obtain county level economic variables at the annual level from the BEA, including county level GDP, employment, and population.

2.2 The Cross-Section of Commercial Banks and Counties

As of June of each year, over the period 1998 to 2020, the average number of US commercial banks in our sample was 7,196. Interestingly, 90% of the aggregate assets among these banks are controlled by 818 banks, on average. The highly skewed size distribution is important for understanding how empirical relationships discovered in the cross section of commercial banks are likely to aggregate to economy-level effects. The specific concern is that the economic behaviors and therefore the empirical relationships among the largest banks may be systematically different from those of smaller banks. Because the largest banks control the vast majority of assets, but represent a relatively small share of the number of observations in a cross-sectional regression, the aggregate consequences and inferences may be poorly measured from standard cross-sectional analyses.

Panel A of Table 1 reports summary statistics for deciles of the bank deposit size distribution as of 2007. This includes data on the number of banks, branches, aggregate share of deposits, assets, loans, business loans. In addition to controlling the vast majority of deposits, banks in the largest decile are also responsible for approximately 90% of bank lending, including business lending by banks.

An important dimension of bank business models that we study is the geographic range of banks' branch networks. We define three types of bank: money center banks, small reach banks, and large reach banks. Money center banks are identified based on the distribution of average branch deposits. In each year, we calculate the cross section of bank-level average deposits per branch. We standardize this distribution and consider all banks that are 2 or more standard deviations above average to be money center banks. These are large custodian banks without a branch network, but extreme branch deposit amounts, such as State Street and Charles Schwab. Intuitively, money center banks are among the largest banks with just 35 banks issuing just under 10% of total deposits in 2007. Small and large reach banks are defined by the number of counties in which their branches operate, with small reach banks operating in fewer than 15 counties and large reach banks operating in more than 15 counties.[12] In 2007, there are 8,405 small-reach banks, some of which are in the top size decile, but mostly these are not the largest banks. There are only 163 large-reach banks and these tend to be among the largest banks, issuing roughly 60% of total deposits.

[12]Note that in 2020, the 95th percentile of the number of counties a bank operates in is 12.

Panel B of Table 2 presents summary statistics by county deposit deciles. As with the bank deposit distribution, the size distribution of counties is also extreme. The counties in the largest decile have 79% of all deposits. There are also some strong patterns across counties sorted by size. There is a tendency for small banks (those not in the largest decile of bank deposits) to dominate smaller counties in terms of market share, while large banks dominate in larger counties. Notably, there is a strong monotonic decline in county-HHI across counties sorted by size and a substantial increase in income per capita in the largest decile counties.

There are some notable differences among the 3 bank types. Figure 1 displays deposit product and branch network characteristics by bank type. The two graphs in the first row plot the average money market and CD offer rates by bank type from 2001 through 2019. Money center banks offer distinctly higher rates for money market accounts, while the average rate differences between small and large reach banks are negligible. Money center banks offer somewhat higher CD rates than other banks, on average, but CD rates are closer to market rates for all bank types.

The large reach banks stand out in several ways. First, the relatively small number of large reach banks issue the vast majority of all deposits, so their rate setting policies will make a substantial contribution to a deposit channel. On average, a large reach banks set 3 distinct rates across 276 branches operating in 56 counties. In contrast, small reach banks, on average, set 1 unique rate across 5 branches operating in 2 counties. The average county-HHI is remarkably similar for the branches of small and large reach banks, but is notably higher in the areas where money center banks operate because the money center bank branches are themselves so extremely large.

Our analyses of bank rate setting policies rely heavily on the RateWatch branch-level offer rate dataset in combination with the FDIC SOD branch-level dataset. Table 2 reports a comparison of the branch coverage for the 3 bank types at various points in time. The first set of rows of Panel A summarize the banks and branches in the SOD dataset containing the universe of banks insured by the. Consistently, over time, the average branch deposits for money center banks is several orders of magnitude larger than for other bank types. Branch deposits for large reach banks are roughly twice as large as they are for small reach banks. As displayed in Figure 1, the branch network size (branches per bank) for large reach banks is approximately 60 times larger than for small reach banks, on average.

The second set of rows in Panel A reports the corresponding summary stats for the sample that we can match to the RateWatch dataset. We require a valid rate and positive deposits to be considered an SOD-RateWatch match. The RateWatch branch coverage is relatively poor in 2007, linking to only 30% of the branches in the SOD. Coverage improves over time, reaching over 70% in 2012, and 80% of all branches in 2017.

Like other empirical research studying banks' branch networks, we rely on the RateWatch dataset for the details of these networks. RateWatch classifies some branches as rate setters and others as followers.[13] It is commonly assumed that each rate setter among a bank's branches identifies a distinct rate setting network. However, there are many instances where a bank has multiple rate setters that all offer the exact same rate. Thus, we distinguish between the number of rate setters and the number of unique rates for each bank at a point in time. For example, in 2012, the average large reach bank has 9 rate setting branches, but sets less than 2 unique rates.

2.3 Uniform Rate Setting Policies

The RateWatch data shows that uniform rate setting is ubiquitous across bank types. Figure 1 and Table 2 report that money center and small reach banks offer only one unique rate for their retail deposit accounts, on average. Large reach banks, despite their vast branch networks, offer on average less than 2 rates per money market product. This is consistent with recent research by Granja and Paixao (2021) and Radecki (1998) using data beginning in the 1990s. The large reach banks have the scope to set different rates in different geographic locations, but choose not to do so. Because of the narrow geographic footprints of the small reach banks and the money center

[13] It is not entirely clear how meaningful the specific rate setting office designation is. We asked RateWatch repeatedly how they determine which branch is a rate setting branch. We obtained the following two answers as of August 2023. "Typically, the rate setter is set by using the head office as first choice. If there are multiple 'geos' or the head office is an operations office (not an actual banking location) the rate setter is next chosen by a branch that is active on a report. If no branches are active on a report or there are several active branches it is simply chosen based on being a valid location (no further criteria offered)." We also obtained this answer by the vendor contact for Ratewatch: "Regarding the rate setter branch. The rate setter branch is the location where we have a contact that provides the rates. Pretty simple."

banks, these banks have little to no scope for setting different rates across geographic markets. In short, all banks are can be described as uniform rate setters.

2.3.1 Data and Rate Setting for Bank of America

In this section we explore both the data consistency between the FDIC SOD and the RateWatch datasets and summarize some key properties of the the rate setting policies of Bank of America (BoA) in Panel B of Table 2. BoA is one of the largest U.S. banks with a national deposit market share of approximately 10% since 2010, based on the FDIC SOD. In 2001, Bank of America is active in 25 states, 182 MSAs, and 574 counties. In 2019, it is active in 37 states, 191 MSAs, and 442 counties.

The SOD-RateWatch match is quite poor in the early part of the sample. In 2001, of its 4325 branches with positive deposits reported in the SOD, only 590 can be matched to a branch with a valid rate in RateWatch. The match improves steadily over time, is nearly complete by 2013. The average branch deposit size is substantially larger among the BoA branches reported in the RateWatch sample than among the BoA branches in the SOD in the years prior to 2010, indicating a selection bias towards larger branches in the first half of the sample.

In 2010, BoA has 6,028 branches across 727 counties and 33 states. RateWatch has a valid rate for 5,334 of these branches and reports that there are 32 rate setting branches for its money market accounts and 31 rate setting branches for its CDs.[14] These rate setting branches generally connect to states. Strikingly, BoA sets only 4 unique rates for its money market accounts and only 3 unique rates for its CDs in 2010. Over time, the number of unique rates has tended to decline, averaging just 1 unique rate across all branches since 2016 to the end of our sample in 2019.

Uniform rate setting by banks severely limits variation in rates across branches per bank, but leaves room for cross-sectional rate differences, across banks and across counties. The top panel of Figure 2 displays the time series of county-level offer rates for money market accounts (MM), calculated as the deposit weighted average offer rate within each county. The average rate across

[14] RateWatch distinguish its rate setting designation by broad product type, i.e., money market account, checking, or certificate of deposits.

counties is depicted as the thick line. There is substantial cross sectional dispersion in county-level offer rates on MM accounts, differing by as much as five percentage points in 2006.

The second panel of Figure 2 plots all the money market account rates Bank of America reported to RateWatch, together with the average offer rate across all counties it is active in. Despite the economically large range of rates across counties and BoA's large geographic reach, BoA offers a very narrow range of money market rates. BoA also tends to offer lower rates than average, with one notable exception during the 2008 Financial Crisis, when BoA substantially increased its deposit offer rates.

2.3.2 Explaining Bank Offer Rates with Fixed Effects

To better understand the sources of variation in branch offer rates, we regress offer rates on a variety of fixed effects and report the adjusted R^2s from these regressions. We aggregate branch offer rates to the bank-county-quarter level, weighting each branch's offer rate by its deposits. Panel A reports results for bank-county-quarter offer rates for money market accounts (MM) with a minimum balance of \$25,000 and one-year certificates of deposits (CD) with minimum balances of \$10,000. Panel B conducts an analogous analysis for the change in MM and CD offer rate spreads, which is the dependent variable of interest in the first stage of the deposit channel (Drechsler, Savov, and Schnabl, 2017). We consider fixed effects representing time (i.e. quarter), county$\times$quarter, bank $\times$ quarter, and the combination of county$\times$quarter and bank$\times$quarter fixed effects. We conduct this analysis for all banks (Columns 1 to 2), small reach banks, i.e., banks active in less or equal to 15 counties (Columns 3 and 4), and large reach banks, i.e., active in more than 15 counties (Columns 5 and 6).

Across all specifications, nearly all of the variation in bank-county offer rates is absorbed by bank-quarter fixed effects. The inclusion of county-quarter fixed effects that capture banks' localized rate setting behavior, adds negligibly to the explanatory power of the bank-quarter fixed effects. For example, when explaining bank-county-quarter money market offer rates at large reach banks, quarter fixed effects produce adjusted R^2 of 0.56, while county$\times$quarter fixed effects produce adjusted R^2 of 0.60, There is clearly substantial variation in offer rates related to time, but after controlling for the time variation, county-level variation is quite modest. In contrast, bank×quarter fixed effects produce adjusted R^2 of 0.95, demonstrating that among the large reach banks there is very little variation to be explained by geographic variation. Indeed, the final specification that includes both bank×quarter and county×quarter fixed effects has an adjusted R^2 of 0.96. This pattern is similar for small reach banks, where the scope for geographic rate setting variation is narrower.

2.3.3 Explaining Offer Rates with Bank Characteristics

Within a bank, there is little variation in offer rates across branches, but there is substantial variation in average rates across banks. We explore the determinants of average rates with regressions of bank average offer rates on a variety of bank characteristics. Park and Pennacchi (2008) develop a model of multi-market bank competition where small single market banks compete with large multi-market banks that use uniform rate setting. One prediction is that a higher prevalence of large banks can harm competition in retail deposit markets. In this spirit, we consider bank size, as measured by both log assets and the log number of counties in which the bank has its branches, the bank's 5-year deposit growth, and the bank's exposure to large reach banks in the counties in which it has its branches. We calculate the exposure to a large reach bank as follows. For each county and year, we compute the share of large reach banks, i.e., those active in more than 15 counties, in terms of numbers and deposits and average across the two. We then form an equal weighted average across counties for each bank and year. Table 4 presents the results for money market rates ($25,000 minimum balance).[15] All regressions include quarter fixed effects, and have standard errors calculated with bank and time clustering.

Large banks[16], those active in numerous counties, and banks more exposed to large reach banks (in line with Proposition 2 of Park and Pennacchi (2008)) offer lower retail deposit rates. Banks

[15] Appendix Table A1 presents very similar results for (12-month, $10,000 minimum balance) certificates of deposits.

[16] Using the RateWatch dataset, d'Avernas et al. (2023) also find that larger banks offer lower rates.

with stronger deposit growth offer higher rates. These are statistically significant effects, but the economic magnitudes are modest. Additionally, these characteristics contribute little incremental explanatory power to the time fixed effects, as adjusted R^2s are essentially unchanged relative to those with fixed effects alone.

A one-standard deviation increase in log asset size reduces MM rates by 4 bps (5% of its standard deviation). A one standard deviation increase in the log of number of counties a bank operates in decreases MM rates by 4 bps. Banks with higher average deposit growth rates pay more: a one standard deviation increase in 5-year average deposit growth is associated with a 7 bps increase in MM offer rates (6% of its standard deviation). After controlling for size, county reach, and deposit growth, being exposed to a large reach bank reduces rates on MM accounts by 1 bps. Note that these effects are average annual effects.

3 Uniform Deposit Rate Setting and the Deposit Channel

Drechsler, Savov, and Schnabl (2017) report an important empirical result that is the basis for much follow-on research in the empirical banking literature. They find that the imperfect passthrough of short-term market rates to deposit rates is related to the deposit market concentration in the counties where branches operate. Moreover, branch-level deposit growth is slower in relatively concentrated markets when short-term market rates rise. They interpret these results as depositors withdrawing their deposits from branches that offer less attractive deposit rates.

To empirically demonstrate that banks set indeed different rates in accordance with their local market power, Drechsler, Savov, and Schnabl (2017) first show that the relation between sluggishness in retail deposit rate adjustment and market concentration exists at the branch-level within a bank. This result is important for two reasons. First, the within bank evidence suggests that the bank-choice mechanism is well-identified. As Drechsler, Savov, and Schnabl (2017) note, "we cannot simply compare deposits across banks because different banks may have different lending opportunities." They further argue that "if banks' lending opportunities decline as the Fed raises rates, then we would see banks make fewer loans and consequently take in fewer deposits even absent a deposits channel." The within-bank result suggests that banks optimally set deposit rates taking into account the deposit market concentration of the geographies in which their branches operate. Second, the result holds among all banks on average, hence also among large banks, which suggests that there is an aggregate economic effect. This finding forms the basis for a theory of a deposit channel of monetary policy and is used by other researchers as a well-identified bank deposit and lending supply shock in follow-on empirical investigations.

The previous section demonstrates the widespread use of uniform deposit rate setting policies among US commercial banks, including for the very largest banks. This raises the question of how to reconcile the common bank behavior of ignoring variation in deposit market concentration in branch-level rate setting decisions with the statistical relation documented in Drechsler, Savov, and Schnabl (2017). Next, we show some critical elements to how Drechsler, Savov, and Schnabl (2017) obtain their results and present evidence that calls into question the empirical validity of the deposit channel mechanism as conceived by Drechsler, Savov, and Schnabl (2017).

3.1 Deposit Spreads

Central to the original Drechsler, Savov, and Schnabl (2017) empirical analysis of deposit spreads is the exclusion of all follower branches. DSS report that follower branches are excluded to avoid redundancy. While it may appear that there is a sort of redundancy in the follower branch rate setting choices (the same rate is "duplicated" across all follower branches), the redundancy rejects the central premise of the deposit channel, which relies on banks' optimal rate choice. Banks choose to set the same rates across all branches within a rate-setter network. Excluding follower branches eliminates the vast majority of all rate setting choices.

It is hard to justify excluding the follower branches on either economic or statistical grounds. First, follower branches make up the majority of all branches, so they are an important component of the cross section of bank branches. Follower branches account for approximately 90% of total branch-level observations in RateWatch. Second, the follower branches clearly do not represent a random sample. The excluded follower branch observations, by definition, do not make rate setting decisions influenced by local market concentration, instead choosing to ignore local deposit market concentration. Third, the rate setting behavior of these branches overwhelmingly reflect the choices of the largest commercial banks who have the most advantaged access to variation in deposit market concentration via their control of the majority of all branches. To the extent that the largest banks choose not to make use of the variation in deposit market concentration speaks directly to the premise being investigated and the potential for any effect detected in small banks to aggregate to a mechanism relevant for the overall banking sector.

Replication of Original Results. To explore the empirical consequence of excluding the follower branches, we first replicate the original branch-level regressions reported by Drechsler, Savov, and Schnabl (2017). The Drechsler, Savov, and Schnabl (2017) sample period is 1997 through 2013. There is a notable limitation to replicating the result exactly. As noted earlier, the dataset that RateWatch currently offers no longer includes data from the years 1997 through 2000, which are included in the Drechsler, Savov, and Schnabl (2017) analysis. Despite our restricted sample, the original Drechsler, Savov, and Schnabl (2017) regressions are well-replicated and displayed in Panel A of Table 5.[17] For each branch b of bank i in quarter t, state s, and county c, we run the same specifications as DSS, relying on their replication code from the QJE website:

$$\begin{aligned}(\Delta \text{FFR}_t - \Delta r^{sav}(b,i,c,s,t)) =& \lambda_1(i,t) + \lambda_2(s,t) + \lambda_3(b) + \lambda_4(c) + \lambda_5(c, p10) \\ &+ \gamma[\Delta \text{FFR}(t) \times \text{county-HHI}(i)] + e_{b,t}.\end{aligned} \tag{1}$$

[17] We access a 2015 version of the RateWatch data, allowing for a closer replication of the findings presented in DSS Table 2. This earlier dataset, however, has limitations for conducting a comprehensive within-bank panel analysis. One significant issue is the absence of a historical mapping of branches to their respective bank owners, which is an additional datafile in current versions of the RateWatch data. This limitation means that for an analysis relying solely on this dataset (see Yankov (2022) for an example of matching banks to branches without the RateWatch data), one can only identify the branch owners as of the end of the sample period, not historically. Since the banking sector underwent considerable consolidation, branch ownership changes substantially over the sample period, meaning that a bank fixed effect will sometimes mistakenly attribute observations from different banks. Consequently, across-bank variation can be incorrectly attributed to within bank variation.

The dependent variable is the quarterly change in branch-level savings deposit rate spreads. Savings deposits rates are the annual rates offered to new $25K savings accounts. Deposit spreads are the difference between the Federal funds target rate and the savings deposit rate. The quarterly change in deposit spreads is regressed on a variety of fixed effects and the key variable of interest: the interaction of branch-level HHI with the quarterly change in the Federal funds rate. Branch-level HHI is the time series average (from 1994 to 2013) of the county-level HHI in which that branch operates.[18] The standard errors are clustered at the county level. The sensitivity of deposit *spreads* to changes in the Federal funds rate reliably increases as county-HHI increases.[19] Columns 1 and 2 include bank x quarter fixed effects, providing direct evidence that within a bank, the sluggishness of deposit rate adjustment is related to market concentration. The regressions reported in columns 3 through 6 allow for across bank variation in county-HHI, which significantly increases the coefficient. Columns 4 through 6 allow for across bank variation and also include branches from banks that operate in only one county, effectively increasing the impact of small banks.

Drechsler, Savov, and Schnabl (2017) include a set of fixed effects defined as county x quarter-is-post-2008 to control for the period after 2008, when the level of the Federal funds rate is near zero.[20] To simplify the presentation and to make use of the extended sample available since the time of the Drechsler, Savov, and Schnabl (2017) analysis, we also report the same regressions for the sample period 2001-2008 in Panel B of Table 5 to verify that this produces essentially the same results. Panel C of Table 5 reports these same regressions for the low interest rate sample period 2009-2020. In this extended period of near zero interest rates, the coefficient on the change in Federal funds rate interacted with county-HHI from the within bank regressions (columns 1 and 2) is small, but indistinguishable from zero.

[18] Note that the main effects of HHI and FFR are absorbed by the county and the time fixed effects.

[19] The deposit spread increases when the difference between the Federal funds rate and the deposit rate increases, which happens when the deposit rate only partially adjusts to changes in the short-term market rate.

[20] While the ZLB $\times$ County fixed effect was not indicated in Table II of the original paper, its inclusion is mentioned on page 1848 of the publication and in the replication code specification for both the spreads and the deposit flow regressions.

Including All Branches. Using Drechsler, Savov, and Schnabl (2017)'s preferred specifications reported in Column 1 and 2 of each Table 5 panel as the baseline, we include the previously excluded follower branches and rerun the analysis. These regressions are reported in Columns 1 and 2 of Table 6. Adding the follower branches increases the number of observations in the main regressions (columns 1 and 2) from around 88K to 1.77M, highlighting the magnitude of the sample restriction in the original regressions. The interaction term coefficients in these specifications are approximately zero (-0.00 and -0.02) and statistically indistinguishable from zero. Thus, the key evidence from the within-bank specifications, supporting the notion that banks actively manage their deposit rate setting based on the geographic deposit market concentration of their branches, is not present in the full sample of branches. These regressions suggest that the statistical reliability of the within bank, branch-level result requires the exclusion of the vast majority of branches – all of the follower branches. This raises doubts about the plausibility of aggregate effects.

Which Banks Drive the Original Results? We investigate which banks contribute most to the original results from the sample restricted to rate setting branches. One insight from the summary statistics in Section 2.3 is that small banks have virtually no scope to engage in differentiated geographic deposit pricing and that largest banks choose not to exploit local deposit market concentration in their deposit pricing. This suggest that the original "rate-setter" result might be driven by a subset of medium/large banks with sufficient geographic reach, and are consequently overrepresented in the rate-setter sample. To identify this subset of banks, we perform a grid-search across different ranges of geographic reach. Specifically, we estimate the main regression (1) for the rate-setter sample along with an interaction term measuring the contribution of banks within a specific geographic range. Appendix A.2 presents the details of this procedure and summarizes the results of this analysis. This search finds that the original rate-setter result resides among banks operating branches in 16 to 35 counties within a year. These banks tend to be large regional banks.[21] Columns 7 and 8 of Table 6 show that the coefficient of interest, from the county-HHI times the change in FFR interacted with a dummy indicating the county range term, is more than twice the

[21] The result is strongest in the tiny subset of banks with 25 to 35 counties.

size of the main effect in Column 5 for banks active in 16 to 35 counties. For smaller reach banks (active in less than 15 counties) or very large reach banks (active in more than 35 counties) there is no reliable relation.[22] Interestingly, for the sub-sample of banks that appear to drive the original rate-setter result, there is no reliable relation once all branches are included in the regression. Columns 3 and 4 of Table 6 show that in the sample that includes all branches, the coefficient on the interaction with 16 to 35 counties is small and indistinguishable from zero. This suggests that among the banks that initially appear to set deposit pricing strategically across counties, they do not achieve a network-level strategic effect.

3.2 Deposit Growth

Central to the empirical evidence of the deposit channel is a relatively negative relation between branch-level deposit growth and changes in the short-term market interest rate in areas of higher deposit market concentration. This presumably reflects the mechanism by which higher deposit spreads, representing higher opportunity costs for depositors, lead to deposit withdrawals from banks. This, in turn, will force banks to restrict their lending.Drechsler, Savov, and Schnabl (2017) provide empirical evidence of a relatively negative relationship between branch-level deposit growth and changes in the short-term market interest rate in areas of higher deposit market concentration. Their focus is again on within-bank specifications, which provide the most compelling evidence as they do not rely on across-bank variation that could be caused by variation in banks' investment opportunities instead of bank choices motivated by market power.

Replication We first replicate the main Drechsler, Savov, and Schnabl (2017) deposit growth analysis using the FDIC Summary of Deposit dataset. Panel A Table 7 studies the relation between branch-level deposit growth and the interaction of market concentration and changes in the short-term market interest rate. The structure of these regressions is the same as the previous deposit spread analysis, but with the annual change in log branch deposits at the as the dependent variable.

[22] Note that in 2020, the median bank is active in 2 counties, the 75th and 95th percentile are active in 4 and 12 counties respectively. The 99th percentile of banks is active in 56 counties.

As before, we focus on the preferred specification by Drechsler, Savov, and Schnabl (2017) that includes bank-time and state-time fixed effects, as well as branch and county fixed effects, and a county-zero-lower bound fixed effect.

Interestingly and in contrast to the deposit spread regressions, this analysis includes all branches of deposit insured banks, including both rate setters and followers. Arguably, it makes sense to exclude the follower branches in the deposit growth analysis. This is because the deposit channel mechanism cannot operate in follower branches whose rates have been set by another branch that may be located in a very different economic environment. Any relation between deposit growth and the interaction of market concentration with changes in the Federal funds rate found in the follower branches must therefore be due to other factors.

The regression results in columns 1 and 3 of Panel A, column 1 are at least as strong as those reported in Drechsler, Savov, and Schnabl (2017). The first column reports results from the sample covering 1994 to 2013, as in the original paper, and column 3 reports results from the period 1994 through 2009. These regressions show that branches in counties with higher market concentration experience larger deposit outflows (or lower deposit growth) in response to a positive monetary policy shock in the pre-Financial Crisis era.

In the main deposit flow regressions, Drechsler, Savov, and Schnabl (2017) include a fixed effect of the county and post-Financial Crisis dummy interaction to allow for differential effects during the "zero lower bound" period following the Financial Crisis. This motivates us to run the regressions separately for pre- and post-Financial Crisis era as shown in Columns 3 and 5 of Panel A of Table 7. Indeed, the deposit flow sensitivity to changes in the FFR interacted with county HHI is not stable over time. In the post-2009 period, the relationship between branch-level deposit growth sensitivities to market interest rates and deposit market concentration is reliably positive. It is not entirely clear that the deposit channel should operate in a similar way when interest rates are near zero, but the reliable positive relation is somewhat unexpected.

Placebo Tests As noted earlier, uniform rate setting policies ignore local market concentration, and therefore the deposit channel, viewed to be working through deposit rates, cannot operate among branches belonging to a uniform rate network. Any relation between deposit growth and the interaction of market concentration with changes in the Federal funds rate found in the follower branches must be caused by other factors. We use this observation to conduct two placebo tests of the deposit channel mechanism that relies on banks' local rate setting.

The first placebo test makes use of the previous analysis that identified the mid-reach banks active in 16 to 35 counties as the banks driving the deposit spread result in the rate-setter sample. Since this is the subset that appears to be using strategic deposit pricing rules, the deposit flow sensitivity should be strongest among the branches of these banks. Columns 2, 4, and 6 in Panel A of Table 7 show that this is not the case. In the pre-crisis period, reliable estimates of a negative deposit flow sensitivity are confined to the small-reach banks that exhibited no reliable tendency to make use of strategic rate setting. In fact, the deposit sensitivity estimates are smallest for the mid-reach banks, suggesting that there is not a direct link between strategic deposit pricing and deposit growth sensitivity.

Panel B of Table 7 summarizes a second placebo test based on estimating the within bank regressions on a sample restricted to follower branches where the deposit channel cannot operate in the way posited by DSS. For this analysis, we identify follower branches within the FDIC branch data by linking them to the RateWatch dataset. This match requires that the regression begin in 2001, which reduces the sample sizes in the pre-crisis periods.[23] Strikingly, these regressions based on follower branches only, find deposit sensitivities that are at least as large in magnitude as those estimated for the all-branch sample in all specifications, despite the deposit channel not operating among this sample.

The placebo results are interesting because they show that there is no evidence of a direct link between strategic deposit pricing and deposit flow sensitivities, as required by the deposit channel version by Drechsler, Savov, and Schnabl (2017). Additionally, the reliable relation between de-

[23]Column 1 of Panel B shows that when the sample begins in 2001, the coefficient size is reduced and becomes insignificant relative to Column 1 of Panel A.

posit flow sensitivity and market concentration among the follower branches indicates that something other than the deposit channel is causing the empirical relationship in this sample.[24] This is important because the follower branches account for 73% of the full branch sample (e.g. the branches in the FDIC SOD dataset that can be linked to RateWatch) used in the initial empirical result and highlights that the identification strategy, even the within bank specifications, appears to breakdown.

4 Evaluating Other Deposit Channel Mechanisms

The specific form of the deposit channel proposed and tested by Drechsler, Savov, and Schnabl (2017) receives no empirical support once all bank branches are considered and when the largest banks are studied. This form of the deposit channel requires banks to adjust branch deposit rates differentially across local markets based on market concentration, but banks do not do this. However, there may be alternative forms of a deposit channel that do operate. In this section, we investigate other properties of a deposit channel to assess the potential for this to be the case.

4.1 Alternative Geographic Market Definitions

As is common in the literature, Drechsler, Savov, and Schnabl (2017) rely on a county-level deposit market definition. It is possible that banks set their network offer rates at a different level of geographic reach. This seems especially plausible for the larger banks, who despite setting few unique rates, may act strategically at a broader geographic market level. To investigate the possibility that the deposit channel operates at a different geographic level, we estimate regressions similar to equation (1) aggregated to bank-county, bank-zip code, bank-MSA, and bank-state levels. The dependent variables are local market bank deposit spreads, calculated from deposit weighted-average offer rates of a bank's branches within that geographic market, as opposed to an individual branch spread. In this way, rate-setting and follower branches within a geographic market are

[24] For example, slower deposit growth in less concentrated markets could be due to heterogeneous demand factors as conceived by a number of papers including Auclert (2019) and Beraja et al. (2019).

combined into a single observation. We calculate an HHI for each level of geographic market definition. The focus remains on the coefficient on the interaction term, $\text{HHI-market} \times \text{dFFR}(t)$, where HHI-market denotes deposit concentration at the county, zip code, MSA, or state level. These regressions are reported in Table 8.

Panel A of Table 8 displays regressions for all banks and Panel B shows regressions for "large reach" banks, defined as those operating in more than 15 counties (note this definition includes the banks previously denoted as regional-reach banks). Across all specifications, the coefficients are statistically indistinguishable from zero, including for the "large reach" banks. Hence, the choice to focus on county-level deposit markets, as opposed to narrower or broader geographic markets, is not a primary reason for our failure to detect a deposit channel in the cross section of commercial banks. Banks' decisions to set deposit rates nearly uniformly across branches and geographic regions, severely limits the potential for deposit channel mechanisms that require variation in local rate setting at the bank level. The fact that this holds for the biggest banks with large geographic reach is consistent with the evidence in Wang et al. (2022), which suggests that there is a national deposit market.

4.2 How does the Stock Market Assess various Measures of Deposit Market Power?

Local deposit market power is viewed to be a powerful feature of bank behavior in the banking literature, and central to the operation of a deposit channel. The analyses in this paper, suggest that market power measured by local deposit market concentration (HHI) does not provide support for a deposit channel. There are perhaps other market power measures that do. In this section we consider several market power measures and look to the stock market for guidance on which are most promising. Specifically, we explore how various market power measures are related to stock market valuations.

For the subset of publicly traded banks, those that operate branches with substantial market power relative to other banks should expect higher valuation multiples if deposit market power is valuable to the owners of the bank. Table 9 reports panel regressions of bank valuation multiples on a variety of bank characteristics, including several market power measures. Following standard industry conventions, we calculate Tier-1 valuation multiples, defined as market capitalization divided by Tier-1 capital. All regressions include quarter fixed effects with standard errors that are clustered by bank. We use the sample of US bank holding companies, which are the entities that closely match the set of publicly-traded banks. We consider three deposit market power measures, including bank-HHI, a new measure we refer to as a rate-gap-flow index, and the deposit productivity measure developed in Egan, Lewellen, and Sunderam (2022) (ELS).

For each bank, we calculate bank-HHI as the deposit weighted average of the county-HHIs where the bank operates branches. We propose another measure for deposit pricing power based on a bank's ability to offer lower rates than other banks within a local deposit market, while maintaining average deposit growth. In this spirit, we calculate branch-level "offer gaps" as the difference between a branch offer rate and the average offer rate in that county for both money market accounts and the 1-yr CD product. A negative offer gap indicates that a branch is offering below local market rates. Each quarter, we standardize (subtract mean and divide by standard deviation) bank-level money market offer gaps, CD offer gaps, and same-branch deposit growth, and then combine these standardized measures to construct a summary measure called "rate gap flow index." The money market and CD components each receive a 25% weight, with the remaining 50% placed on deposit growth.

The first specification includes only the bank-HHI, which has a negative coefficient that is statistically indistinguishable from zero. The coefficients on the rate gap flow index and the ELS deposit productivity measure are both reliably positive with t-statistics of 5.8 and 8.4, respectively. Specification 4 reports the relation of various control variables, showing that bank size, measured as log assets, and return on equity (ROE), calculated as net income divided by Tier-1 capital, are reliably positively associated with market valuations. Bank size and ROE are able to explain a substantial amount of the variation above that explained solely by the time fixed effects, as the adjusted-R2 increases from 0.38 to 0.53. The remaining specifications re-examine the relationships between market power measures and valuation multiples including the control variables, and show that inferences remain the same.

These regressions indicate that the stock market does not value banks that operate in relatively concentrated deposit markets higher than other banks. In fact, to the extent that there is a relationship between valuation and market concentration, it is marginally negative. This is inconsistent with the common notion that county HHI is an accurate measure of deposit market power. The rate gap flow index and the ELS deposit productivity measures are strongly related to market valuation multiples and may therefore be better market power proxies.

4.3 Big Banks and Aggregate Effects

The deposit channel posits that the imperfect passthrough of market rate increases represents increased opportunity costs of holding (investing in) deposits for bank depositors, which drives deposits out of the banking system. Banks cannot perfectly offset this loss of funding and consequently restrict lending. There are several implicit elements in this story that are worth making explicit.

First, the since large banks disregard variation in local deposit markets in their rate setting policies, it seems reasonable to expect deposit pricing power to operate at the bank-level rather than by geographic region. From the bank perspective, the spread between the FFR and deposit rates is assumed to reflect deposit market pricing power. Deposit market concentration, measured with HHI, is one measure of market power, but may not accurately reflect bank-level market power. The previous analysis suggests that there may be other measures of bank-level market power that provide more support for a deposit channel.

Second, from the depositor perspective, the spread between the FFR and deposit rates is assumed to accurately reflect an opportunity cost for depositors, as if these deposits represent investments, rather than a means of payment. The roughly 20% of bank deposits that pay zero interest suggests that not all deposits are viewed as investments by depositors. To the extent that some deposits are held for transaction services, a portion of the spread represents the value of these transaction services.

Third, deposit accounts that offer market rates are not expected to be part of the deposit channel. The large money center banks offer rates close to market rates on money market accounts (see Figure 1), and time deposits rates are generally close to market rates for commercial banks on average Begenau and Stafford (2020). The deposit channel posits that on the margin the portion of deposits that are part of a deposit channel will be rebalanced out of the bank and that there will be no funding substitutes available to finance otherwise positive NPV lending opportunities. Non-time deposits that are rebalanced into time deposits at the same bank should not change NPV estimates, which should be based on market discount rates for banks to benefit from their deposit market power. Similarly, substituting debt funding for withdrawn deposits must not be available for banks to find themselves financially constrained.

Finally, the deposit channel must be operating among the largest decile of banks or there will not be a quantitative effect. As Table 1 reports, the extreme bank size distribution results in the largest 10% of banks controlling roughly 85% of loans and deposits. Cross-sectional regressions describe average relationships. It does not directly follow that robust cross-sectional relationships will aggregate. If the nature of the relationship is different among the relatively few largest banks that control the vast majority of assets and deposits, the average relationship estimated from cross-sectional regressions may be a poor proxy for a dollar-weighted relationship.

Bank-Level Deposit Channel Patterns. To explore these features of the deposit channel, we first analyze the proposed deposit channel relationships at the bank-level. In addition to considering the HHI market concentration measure, we also consider the rate gap flow index and the ELS deposit productivity measures as proxies for bank-level deposit market power. Following Drechsler, Savov, and Schnabl (2017), we evaluate the sensitivities of bank-level deposit spreads, deposit growth, and loan growth to changes in the Federal funds rate by various market power measures. We initially focus on the pre-2009 period, where the initial evidence of a deposit channel was found.

Over the period 1998 through 2008, we estimate regressions of the form:

$$y(i,t) = b_0(i) + b_1 \times \text{MarketPower}(i,t) + b_3\left[\Delta\text{FFR}(t) \times \text{MarketPower}(i,t)\right] + b_4(t) + e(i,t), \quad (2)$$

with standard errors clustered at the bank and quarter level. The coefficient of interest in these regressions is b_3. We also include quarter- and bank fixed effects. There are three dependent variables, corresponding to each of the three stages of the deposit channel mechanism. The dependent variable for the specification reported in Column 1 is the quarterly change in bank deposit spreads, where the deposit rate is measured as the quarterly deposit interest expense divided by the average of the beginning and ending balance of deposits. The dependent variable in column 2 is the change in log deposits and the dependent variable in column 3 is the change in log loans. The predicted signs for b_3 are positive for the change in deposit spreads, and negative for both deposit and loan growth. These three regressions are performed using each of the three market power measures, calculated as described above.

Panel A of Table 10 reports results using the full cross-section of commercial banks for each of the three market power definitions. The first specifications, based on HHI, essentially replicate the results reported in Table 8 in Drechsler, Savov, and Schnabl (2017). These regressions find robust cross-sectional patterns supporting the notion of the deposit channel based on HHI. Panel B reports regression results for the sub-sample of "big" banks, where "big" is as defined earlier – the largest banks representing 90% of aggregate commercial bank assets. Among the relatively few banks that control virtually all of the aggregate assets and deposits, there is no evidence to support the notion of a deposit channel based on HHI as a measure of market power. In the sample of large banks, the interest rate sensitivities of deposit spreads and loans are essentially zero and the coefficient on deposit growth is reliably positive, while the deposit channel predicts it will be negative.[25]

Table 10 also reports results using the rate gap flow index and the ELS deposit productivity measures as proxies for bank-level market power. Higher values for these measures are associated with higher valuation multiples (see Table 9), consistent with the notion that variation in these measures reflect how different bank-level deposit franchises vary in the value they generate for bank owners. The set of relationships predicted by the deposit channel do not hold for either of

[25]This is consistent with work by Schaffer and Segev (2022) building on Adams, Brevoort, and Driscoll (2023).

these measures, in the full cross-section of commercial banks or among the sample of big banks. Interestingly, the coefficient of the dSpread on the ELS Deposit Productivity x dFFR is reliably negative, indicating that banks with highly productive deposit franchises tend to adjust rates relatively quickly.

The results in Table 10 push against the notion of a deposit channel aggregating to have a quantitative effect, as the predicted empirical relations do not hold among large banks using the HHI market power measure, and do not hold at all using two alternative bank-level deposit market power measures. Since large banks account for 85% of total commercial banks assets, deposits, and loans the predicted relationships are likely to be required to exist within this sample to produce a consequential aggregate effect.

Aggregate Deposit Channel Patterns. As a final analysis to investigate the scope for an aggregate deposit channel, we examine the sensitivity of aggregate deposit growth to changes in the FFR, and decompose deposits into those expected to be part of the deposit channel (DC deposits) and those not expected to be part of the deposit channel (notDC deposits). In addition, we examine the sensitivity of bank debt to explore the possibility of banks' substituting debt for deposits. We define DC deposits as domestic deposits minus domestic time deposits minus domestic non-interest bearing deposits; and define notDC deposits as deposits minus DC deposits. We measure bank debt as the sum of Fed funds purchased and repo funding, trading liabilities, other borrowed money, and subordinated notes. We estimate two regression specifications of the form:

$$dLog(D(t)) = b_0(i) + b_1 \times \Delta\text{FFR}(t) + e(i,t), \tag{3}$$

where D is one of {deposits, DC deposits, notDC deposits, debt, notDC deposits + debt}. These regressions are estimated using the sample of commercial banks over the period 1985 through 2019, which is referred to as the full sample. We exclude the COVID-related period following 2019, where there are extreme deposit inflows related to the CARES Act. We also consider two sub-periods, defined as the first and second halves of the full sample, ranging from 1985 through the second quarter of 2002, and the from the third quarter of 2002 through 2019. We consider one specification that includes only the contemporaneous change in the Federal funds rate and another specification that includes four lags of the change in the FFR.

Table 11 reports the results from these regressions. For aggregate deposits, across all three sample periods, there is no reliably negative relation between the change in log deposits and the Federal funds rate, either with or without lags. In fact, in the first half of this sample in the specification with lags, there is a reliably positive relation. This indicates that the main effect of a deposit channel of monetary policy that has been further investigated with cross-sectional variation in bank market power, is itself not a strong effect, at least as measured with total deposits.

Table 11 also reports estimates of the deposit growth interest rate sensitivities for the subset of deposits that we identify as being most central to a deposit channel, referred to as DC deposits. Strikingly, there is a reliably negative relation between DC deposit growth and dFFR in all considered specifications with t-statistics ranging from -2.2 to -5.8. This is consistent with the notion that if a deposit channel exists, it is likely restricted to a subset of deposits that can plausibly be considered investments offering below market rates from the depositor perspective. Crucially, the deposit channel requires that there be no substitutes for these deposits. The remaining panels report results exploring this notion with regressions of the notDC deposits and bank debt. The growth in the balances of these alternative bank funding sources have reliably positive interest rate sensitivities, effectively offsetting the sensitivity of the DC deposits. Together these results suggest that in the aggregate there is substantial substitutability between interest rate sensitive deposits and other deposits, as well as with non-deposit bank debt.[26]

5 Discussion

Our investigation of the identification failure uncovers some interesting empirical observations: 1. Identification relies on deposit demand sensitivities to dFFR to be similar across BoA depositors

[26]This is consistent with Whited, Wu, and Xiao (2022).

in Santa Clara and Shasta, except for the BoA rate adjustment differences due to different market concentrations. 2. Placebo shows that these sensitivities are different despite no rate adjustment differences, so variation in HHI is picking up something else. 3. Lots of possibilities of how depositor-types can vary in important ways within a state related to the density of the deposit markets. 4. We have 3 potentially useful observations: a. There is a lot of variation in bank-cnty deposit flow that is unexplained by bank-time and county-time FEs b. County deposit growth is reliably linked to county economic and population growth. And linked to FFR x population growth (as good as stupid HHI) c. The deposit growth within the geographic footprint of a bank's regional footprint is a strong predictor of a bank's deposit growth. d. Together these suggest that demand factors are a promising future avenue to understand bank deposit flows and in that same vein heterogeneous household demand channels could be an important source of monetary policy transmission, not banks.

In this section, we discuss some potential implications of our findings for future research into the deposit channel. Regional-bank level demand shocks may be important drivers of deposit flows. Recall that the key assumption for the empirical validation of the deposit channel of monetary policy, as conceived by Drechsler, Savov, and Schnabl (2017), rests on different local deposit spreads driving the deposit flow differences within the same bank-time and state-time pair across branches. To reliably identify the deposit flows driven by a bank's deposit pricing decisions, a bank's depositors in different counties must respond similarly to monetary policy changes except for the bank's differential rate adjustments chosen based on differential market concentration. For example, a Bank of America depositor in a wealthy county like Santa Clara, known for Palo Alto and Silicon Valley, must have similar deposit demand sensitivities as a BoA depositor in Shasta County, known for outdoor recreation and harvesting timber. Our placebo test demonstrates that deposit flows vary reliably across branches of the same bank-time and state-time pair, despite there being no variation in deposit pricing. Thus, the variation in market concentration is capturing variation in local deposit demand sensitivities related to something besides a bank's rate setting decisions.

There are many possibilities. For example, certain depositor-types may prefer some banks over others as the 2023 regional banking crisis has shown (Jiang et al., 2023a,b). Depositor-type demand shocks may give rise to regional-bank specific deposit flows that are unrelated to bank rate-setting policies, suggesting another direction for future research looking for other forms of a deposit channel.

It is notable how much variation there is in deposit flows (i.e. same-branch deposit growth) at the bank-county level that is unexplained by bank and county fixed effects. Table 12 reports regressions of bank-county-year deposit flows on various fixed effects and report adjusted R^2s, as in the earlier analysis for deposit offer rates. Specifically, we consider year, county-year, bank-year, and the combination of bank-year and county-year fixed effects. We run regressions for the full commercial bank sample (column 1), as well as separately for small reach (column 2) and large reach banks (column 3). The year fixed effects and county-year fixed effect produce adjusted R^2s ranging from 0.02 to 0.04 for same-branch deposit growth, reported in Panel A. The bank-year fixed effects produce substantially larger R^2s, ranging from 0.15 to 0.17, with minimal differences between small and large reach banks. Thus, over 80% of bank-county-year deposit growth remains unexplained.

At the county-level, deposit growth is reliably linked to county economic and population growth. Moreover, there is a county-growth monetary policy link. Table 13 reports the results from regressions of county-level deposit growth (three-year county aggregate deposit growth rates) on various measures of county-level economic growth, population growth, the share of large banks, and the interaction effects with changes in the Federal funds rate. We study three year growth rates because the effects of economic growth may take time to manifest in deposits. All regressions include state and year fixed effect and cluster standard errors at the year and county level.[27] The growth rate of the county's population, employment, and GDP are closely related to the growth of the county deposit. In addition, the sensitivity of county deposit growth to economic growth variables also depends on changes in the Federal funds rate.

[27] When we cluster the standard errors at the county level only standard errors are smaller. When we use only non-overlapping observations and cluster at the county level the results look very similar.

At the county-level there is a reliably positive relation between deposit growth and population growth (t-statistic of 7.4) and with the interaction term of population growth $\times$ the change in the FFR (t-statistic of 3.1). The economic magnitudes are large as well. An increase in a county's population growth rate by one percentage point is associated with increased deposit growth of 0.83 percentage points, conditional on no change in the Federal funds rate. This may seem tautological: when a county experiences a net inflow of people, at least some will bring deposits, open new accounts, and contribute to economic activity in that region. The sensitivity of county deposits to the interaction of economic fundamentals and changes in the Federal funds rate points to regional differences in the way monetary policy affects the economy. One example of recent research studying heterogeneous regional effects of monetary policy shocks is Beraja et al. (2019), who finds regional variation in households' propensity to refinance mortgages. This variation in monetary policy effectiveness between regions can be linked to differences in housing market characteristics, such as the prevalence of housing equity and the responsiveness of housing supply.

Perhaps county-level (or regional) deposit growth operates more independently of bank behavior than commonly assumed. At the same time, there is likely an important role of county-level economic performance on bank performance. We look to see how well the county deposit growth within a bank's geographic footprint is able to predict the bank's deposit flows. Table 14 presents regressions of bank deposit flows on the "footprint" deposit growth. The footprint deposit growth is measured as the value-weighted deposit growth of the county deposit growth in which a bank operates branches. We also consider two measures of predicted footprint growth based on county flows predicted by either county population or county GDP growth. Table 14 reports these regression results, indicating that footprint deposit growth is a strong predictor of bank deposit growth based on all three measures, for both small-reach and large-reach banks. These regressions are consistent with the idea that exposure to regional shocks is an important driver of bank deposit flows.

Together, these findings suggest that the variation in geographic demand factors may be important for improving our understanding of bank deposit flows. Moreover, it may even turn out that heterogeneous household demand channels are more important sources of monetary policy transmission than banks.

6 Conclusion

From the perspective of deposit channel theories, banks appear to leave economic rents on the table. There is widespread use of uniform deposit rate setting policies among US commercial banks. Large banks have a near universal use of uniform deposit rate setting policies across large geographies. This severely undermines the empirical identification strategy relied upon in the initial research that finds evidence of a deposit channel of monetary policy. The crucial first stage of the deposit channel, whereby banks choose to more sluggishly adjust their deposit rates at their branches operating in highly concentrated deposit markets, cannot operate within branch networks relying on uniform deposit rate setting policies. The earlier research finds a robust empirical relation supporting the notion of a deposit channel because it excludes all follower branches, accounting for over 90% of branch observations. When all branch observations are considered, there is no within bank result.

The within bank result is important because it relatively well-identifies a bank choice to set branch-level deposit rates based on their local market power. Exploiting within bank variation in rate adjustment skirts the empirical challenges of relying on across bank-time variation that may be due to variation in local market conditions rather than bank supply. We find that in the second-stage of the deposit channel, where deposit growth in highly concentrated deposit markets is relatively slow due to banks' choices to more sluggishly adjust these deposit rates than those of their other branches, the predicted empirical relation is just as strong in follower branches as it is in rate setting branches. However, the deposit channel cannot operate within the follower branches since, by definition, their rate setting policies ignore local deposit market concentration. This indicates that the reliable empirical relation in branch-level deposit growth is caused by something other than the deposit channel.

Our bank-level analyses of the deposit channel demonstrate that patterns detected in the cross-section of banks may be misleading for drawing inferences about aggregate effects because of the extreme bank size distribution combined with differential behaviors of large and small banks.[28] For example, the bank-level patterns in deposit spreads, deposit flows, and loan growth appearing to support the deposit channel based on HHI, are unreliable in the sample of large banks, with the deposit flow relation reliably in the wrong direction. These cross-sectional findings from the sample restricted to large banks are consistent with our time series results on the aggregate deposit sensitivity to interest rate changes showing a statistically weak relationship.

The deposit market concentration index, HHI, is a popular measure of bank market power in the empirical literature, but may not accurately reflect deposit market power. Consistent with our evidence suggesting that access to deposit market power is essentially ignored by large banks, the stock market values banks with branches operating in relatively concentrated deposit markets no higher than other banks. Thus, there is little evidence that either banks or the stock market view differential access to deposit market concentration to be a source of economic value.

Finally, our reexamination of the deposit channel evidence highlights the importance of the role played by financial constraints in the operation of the overall mechanism, and the current lack of direct evidence of this component of the channel among large banks. Central to the overall mechanism is the lack of alternative sources of financing when banks face interest rate driven deposit withdrawals. In the aggregate deposit data, we find strong evidence of substitutability among deposit types and non-deposit debt. Documenting the financial constraints of large banks in rising interest rate environments remains an important open empirical exercise necessary for establishing the validity of a deposit channel.

[28] Similarly, we find there are meaningfully different behaviors between money center banks and other large banks.

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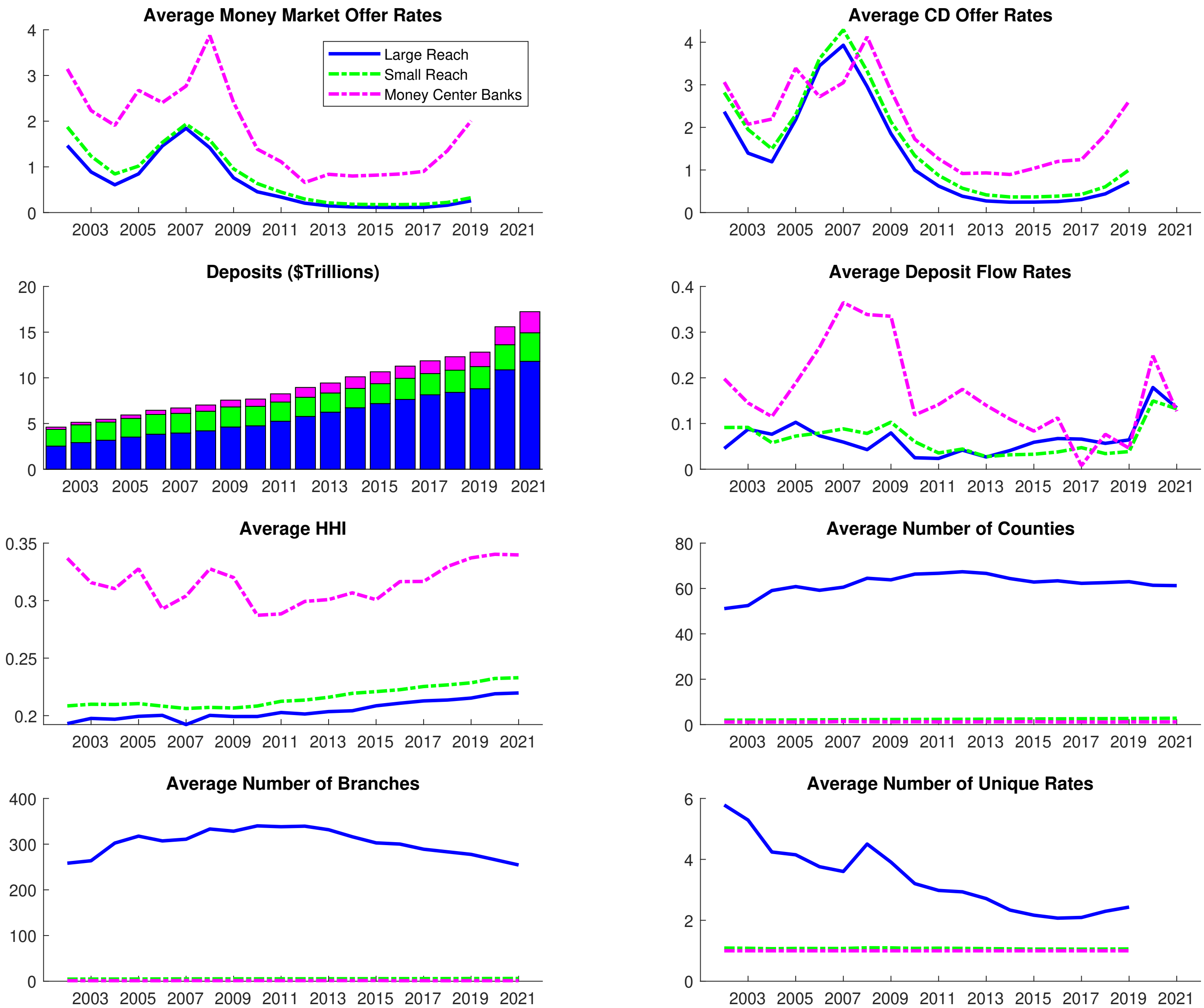
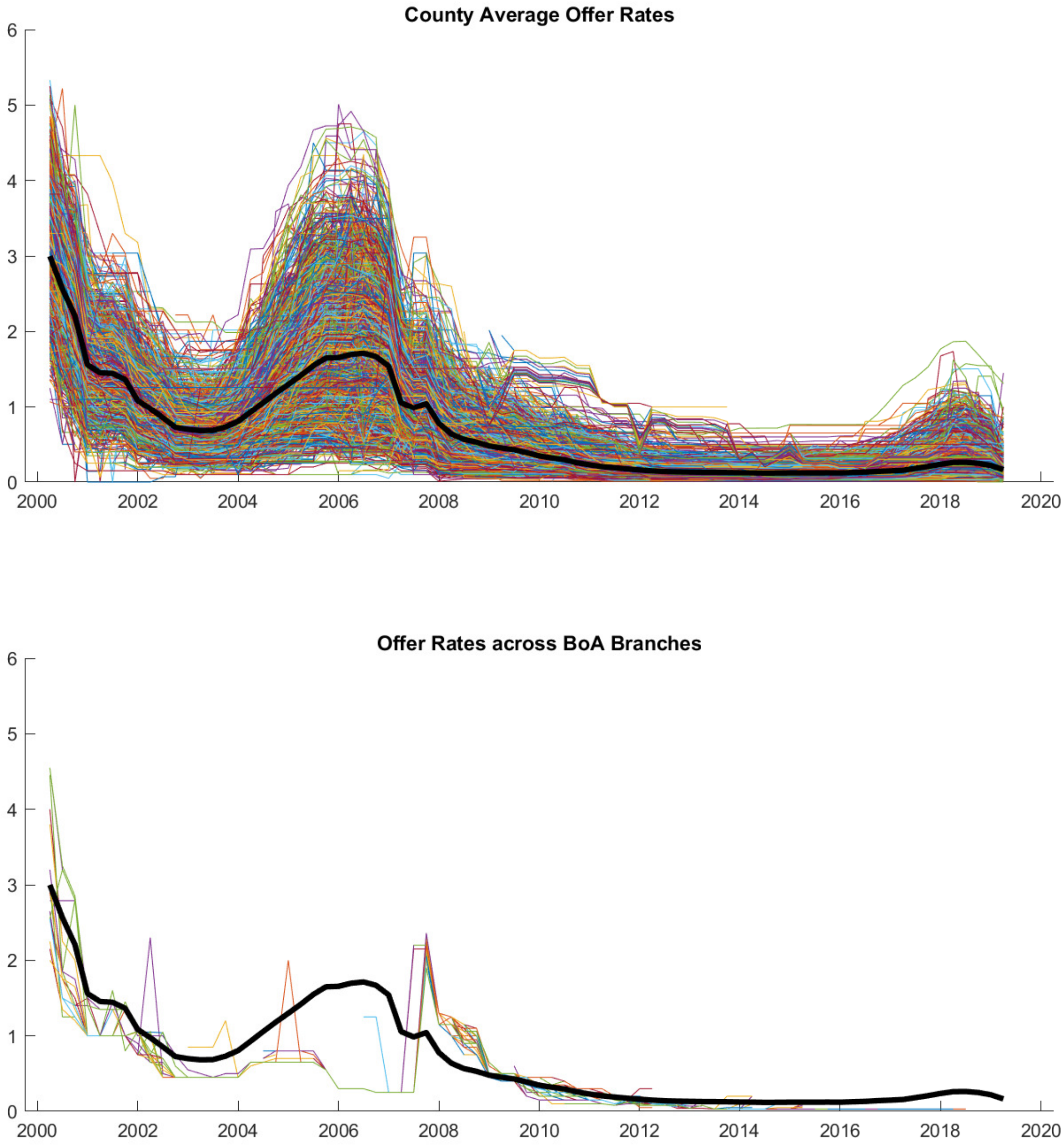
Figure 1: Summary by Bank Type



Notes: This figure presents a data summary by bank type from 2001 to 2019. Money Center banks are defined based on the distribution of average branch deposits across banks, d, in a given year: $Z = (\mathrm{d} - \mathrm{mean}(\mathrm{d}))/\mathrm{std}(\mathrm{d}) > 2$ is classified as a money center bank. Small (Large) Reach Banks are defined as banks active in less or equal to 15 (more than) counties, excluding money center banks. The average money market offer rate is the deposit weighted money market account offer rate (minimum $25,000) by bank type. The average CD offer rates is the deposit weighted certificate of deposit offer rate (minimum $10,000 and 1-year term) by bank type. Deposits are the aggregate deposit amounts by bank type. Average deposit flow is the change in the log of total deposits by bank type. Average HHI is the average bank-HHI, calculated as the value-weighted HHI across the counties in which its branches operate. Average number of counties (branches) is an average number of counties (branches) in which a bank is active in, by bank type. Average number of unique rates is the average number of distinct rates offered by each bank type. Deposit data are from the FDIC Summary of Deposits and offer rate data are from RateWatch.

Figure 2: Cross-Sectional Rate Dispersion and Within Bank of America Rate Dispersion



Notes: This figure presents money market account offer rates ($25,000 minimum) from 2001 to 2019. The top panel shows offer rates across all counties using offer rate data from RateWatch and branch deposit data from the FDIC Summary of Deposits. County-level offer rates are deposit weighted offer rates. The mean county offer rate is depicted as the thick black line. The bottom panel presents all rates offered by Bank of America across all of its branches in the US for its money market accounts. The thick black line is the mean county offer rate.

Table 1: **Summary Statistics**

Panel A: Summary by Bank Deposit Deciles

	1	2	3	4	5	6	7	8	9	10
Number of Banks	860	861	860	860	862	861	860	860	861	860
Number of Branches	1,022	1,308	1,613	1,954	2,454	2,998	3,801	5,011	7,810	65,847
Agg Deposit Share	0.2	0.4	0.6	0.9	1.2	1.6	2.2	3.2	5.4	84.4
Agg Asset Share	0.2	0.3	0.4	0.6	0.8	1.1	1.5	2.2	3.8	89.1
Agg Loan Share	0.1	0.3	0.5	0.7	0.9	1.3	1.8	2.6	4.6	87.2
Agg Bus. Loan Share	0.1	0.2	0.3	0.5	0.8	1.0	1.3	2.0	3.2	90.5
Money Center Share	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.4
Small Reach Bank Share	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.8	99.7	19.6
Large Reach Bank Share	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	70.0

Panel B: Summary by County Deciles

	1	2	3	4	5	6	7	8	9	10
Number of Counties	321	320	321	321	321	321	321	321	320	321
Number of Banks	384	659	860	1,076	1,215	1,394	1,576	1,729	2,091	3,918
Number of Branches	635	1,211	1,627	2,268	2,941	3,887	5,159	7,420	13,414	55,262
Agg Deposit Share	0.2	0.5	0.7	1.0	1.4	2.0	2.8	4.2	8.2	79.0
Avg Branches Not Big	1.4	2.8	3.7	5.1	6.3	8.1	10.1	12.2	18.0	41.4
Avg Branches Big	0.6	1.0	1.4	2.0	2.9	4.0	6.0	10.9	23.9	130.8
Avg HHI	0.76	0.47	0.40	0.32	0.28	0.25	0.22	0.20	0.17	0.16
Avg Income PerCap	29.6	28.8	29.0	29.2	29.1	30.1	31.0	33.3	34.9	42.6
Money Center Bank Share	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.1
Small Reach Bank Share	68.3	69.5	73.0	71.9	67.8	67.8	63.5	56.7	47.1	25.5
Large Reach Bank Share	31.7	30.5	27.0	28.1	32.2	32.2	36.5	43.3	52.9	63.5

Notes: This table presents summary statistics across the size distribution of banks (Panel A) and the size distribution of counties (Panel B). Panel A sources data from the FDIC Summary of Deposits (SOD) dataset and the Commercial Bank Call Reports and aggregates it to the bank level as of June 2007. Panel B sources data from the BEA and the SOD as of 2007. Agg. Deposit/Asset/Loan/Business Loan Share is based on commercial bank data. Money Center banks are defined based on the distribution of average branch deposits across banks, d, in a given year: $Z = (\mathrm{d} - \mathrm{mean(d)})/\mathrm{std(d)} > 2$ is classified as a money center bank. Small (Large) Reach Banks are defined as banks active in less or equal to 15 (more than 15) counties. Avg Branches Big is the average number of branches per bank for banks whose assets accumulate to 90% aggregate share. Avg Branches Not Big is the average number of branches per bank for all other banks. Avg Income perCap is the average income per capita for a given county decile. Avg HHI is the average deposit market concentration.

Table 2: **Comparing the SOD and RateWatch Datasets**

Panel A: SOD and RateWatch Match Characteristics by Bank Type

	2007			2012			2017		
	MC	SR	LR	MC	SR	LR	MC	SR	LR
Num Banks	35	8,405	163	35	7,053	166	30	5,576	191
Num Branches	54	43,099	50,660	49	37,466	56,330	39	31,680	55,182
Avg Branch Deposits	10,867	50	78	21,915	56	102	35,727	73	148
National Mkt Shr	0.09	0.32	0.59	0.12	0.23	0.65	0.12	0.20	0.69
Avg Bank HHI	0.30	0.21	0.19	0.30	0.21	0.20	0.32	0.23	0.21
Num Banks (RW)	2	5,558	143	3	5,136	154	2	3,943	175
Num Branches (RW)	2	14,060	14,364	3	24,681	43,759	2	23,168	47,607
Num Rate Setters per Bank	1	1	7	1	1	9	1	1	8
Num Unique Rates per Bank	1.0	1.1	2.9	1.0	1.0	1.9	1.0	1.0	1.5
Branches / Rate Setter	1.0	2.4	13.5	1.0	4.5	33.1	1.0	5.5	33.8
Branches / Unique Rates	1.0	2.4	34.1	1.0	4.6	151.9	1.0	5.7	175.7
Mean APY	2.73	1.93	1.44	0.57	0.22	0.12	0.97	0.16	0.06

Panel B: Bank of America Coverage in SOD

Year	2001	2004	2007	2010	2013	2016	2019
National Mkt Shr	0.074	0.073	0.089	0.108	0.108	0.107	0.106
Num Branches	4,325	4,291	5,728	6,038	5,399	4,753	4,336
Num Counties	574	584	694	727	663	472	442
Num MSAs	182	181	215	235	227	190	191
Num States	25	23	31	36	35	34	37
Avg Branch Deposits	74	93	104	137	189	253	312

Panel C: Bank of America Coverage in RateWatch

Year	2001	2004	2007	2010	2013	2016	2019
National Mkt Shr	0.023	0.035	0.041	0.095	0.105	0.104	0.102
Num Branches	590	1,320	2,007	5,334	5,224	4,616	4,211
Num Counties	397	491	611	685	640	465	439
Num States	21	21	30	33	33	34	34
Avg Branch Deposits	170	143	137	136	190	254	311
$25K Money Market							
Num Rate Setters	20	21	30	32	31	30	27
Num Unique Rates	10	2	2	4	2	1	1
$10K 1-year CD							
Num Rate Setters	20	21	29	31	31	30	27
Num Unique Rates	6	3	14	3	2	1	2

Notes: This table compares data from the Summary of Deposits (SOD) with RateWatch. Panel A summarized all banks, where the first set of rows rely on data from SOD, second set of rows rely on the RateWatch dataset. Panel B summarizes data for Bank of America using the SOD dataset. Panel C summarizes data for Bank of America using the RateWatch dataset. MC denotes money center banks, identified based on the cross-sectional distribution of bank-level average deposits per branch. We standardize this distribution and consider all banks that are 2 or more standard deviations above average to be money center banks. SR denotes small-reach banks, which are not MC and operating in 15 or fewer counties. LR denotes large-reach banks, which are not MC and active in more than 15 counties. Avg Branch Deposits are average branch level deposits in $millions. National Mkt share is the bank type specific deposit market share. Avg Bank HHI is the average of bank-HHI, calculated as the deposit weighted average of the county-level HHIs in which that bank's branches operate, as in Drechsler, Savov, and Schnabl (2017). Num Rate Setters per Bank is the number of rate setting branches according to RateWatch. Mean APY is the average money market ($25K balance) offer rate.

Table 3: **What Explains Bank-County Rates?**

Panel A: Offer Rate Level

	MM All Banks	CD	MM Small Reach Banks	CD	MM Large Reach Banks	CD
	(1)	(2)	(3)	(4)	(5)	(6)
R^2 Qtr	0.59	0.88	0.65	0.89	0.56	0.90
R^2 Cnty-Qtr FE	0.63	0.89	0.70	0.92	0.60	0.90
R^2 Bank-Qtr FE	0.97	0.99	0.98	1.00	0.95	0.99
R^2 BQ-CQ FE	0.97	0.99	0.98	1.00	0.96	0.99
N	1,085,424	1,130,856	463,888	482,318	528,870	556,880

Panel B: Change in Offer Spreads vis-a-vis the Federal Funds Rate

	MM All Banks	CD	MM Small Reach Banks	CD	MM Large Reach Banks	CD
	(1)	(2)	(3)	(4)	(5)	(6)
R^2 Qtr	0.79	0.65	0.82	0.67	0.77	0.66
R^2 Cnty-Qtr FE	0.80	0.66	0.84	0.69	0.78	0.66
R^2 Bank-Qtr FE	0.95	0.93	0.98	0.98	0.93	0.92
R^2 BQ-CQ FE	0.96	0.94	0.99	0.98	0.94	0.92
N	1,044,751	1,091,642	442,998	461,693	509,843	539,186

Notes: This table presents R^2s regressions of bank-county offer rates and bank-county changes in deposit spreads on various fixed effects. Panel A presents the R^s of fixed-effect regressions for the level of offer rates. Panel B studies the change in the spread between the Federal funds rate (FFR) and a bank-county level offer rate. Quarterly bank-county offer rates are calculated from the RateWatch dataset over the period 2001-2019. Deposit spreads are measured as the difference between the Federal funds rate and the branch deposit offer rate. Offer rates for both $25K savings deposit accounts (MM) and 12-month certificates of deposits with a minimum balance of 10K (CD) are considered. We investigate the role of time (quarter), time-county, bank-county, and bank-county and time-county fixed effects in explaining the variation in deposit offer rates and changes in deposit spreads. Small (Large) Reach Banks are defined as banks active in 15 or fewer (more than 15) counties, excluding money center banks (as described in Section 2.3.

Table 4: **How Do Banks Set Rates?**

	Dependent Variable: Rate Level mm					
	(1)	(2)	(3)	(4)	(5)	(6)
Log Assets	-0.031					-0.023
	(-7.87)					(-5.01)
Log Counties		-0.051				-0.034
		(-9.98)				(-5.51)
Deposit Growth (5yr avg)			0.005			0.006
			(7.57)			(9.39)
Exposure to Large Reach Banks				-0.035		-0.073
				(-1.30)		(-3.72)
Pop. Growth (5yr avg) of Footprint					0.013	0.005
					(2.21)	(1.16)
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
R^2 just FE	0.68	0.68	0.68	0.68	0.68	0.68
R^2	0.68	0.68	0.69	0.68	0.68	0.69
N	388,707	388,707	388,707	388,707	388,707	388,707

Notes: This table presents cross-sectional regressions of quarterly bank-level offer rates for money market accounts (MM), see Appendix Table A1 for regressions explaining certificates of deposits offer rates. Log Assets is the log of total assets. Log counties is the log of the number of counties in which the bank has its branches. Deposit growth (5yr avg) is a bank's 5-year same-branch deposit growth (i.e. growth from its initial set of branches). Exposure to Large Reach Banks is calculated as follows: for each county-year, we compute the share of large reach banks, i.e., those active in more than 15 counties, in terms of counts and deposits and average the two. We then average across counties for each bank-year. Population Growth (5yr avg) is the county-level population growth averaged over the counties in which the bank operates branches. The regressions include quarter (time) fixed effects. Standard errors are clustered by bank and quarter.

Table 5: **Federal Funds Rate Passthrough on Deposit Spreads Rate Setting Branches**

Panel A: 2001-2013

	Dependent Variable: Δ Savings Rate Spread					
	At least 2 Counties			All		
	(1)	(2)	(3)	(4)	(5)	(6)
HHI x dFFR	0.07	0.06	0.18	0.14	0.14	0.14
	(2.15)	(2.14)	(3.84)	(5.23)	(5.99)	(6.23)
Bank-Qrt FE	Yes	Yes	No	No	No	No
State-Qrt FE	Yes	No	No	Yes	No	No
Branch FE	Yes	Yes	No	Yes	Yes	No
County FE	Yes	Yes	Yes	Yes	Yes	Yes
County X ZLB FE	Yes	Yes	Yes	Yes	Yes	Yes
Qrt FE	No	No	Yes	No	Yes	Yes
R^2 FE only	0.86	0.86	0.62	0.64	0.63	0.64
Adjusted R^2	0.86	0.86	0.62	0.64	0.63	0.64
N	88,426	88,426	88,426	299,261	299,261	299,261

Panel B: 2001-2008

	Dependent Variable: Δ Savings Rate Spread					
	At least 2 Counties			All		
	(1)	(2)	(3)	(4)	(5)	(6)
HHI x dFFR	0.07	0.07	0.18	0.14	0.14	0.14
	(2.04)	(2.19)	(3.88)	(5.17)	(5.94)	(6.27)
Bank-Qrt FE	Yes	Yes	No	No	No	No
State-Qrt FE	Yes	No	No	Yes	No	No
Branch FE	Yes	Yes	No	Yes	Yes	No
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Qrt FE	No	No	Yes	No	Yes	Yes
R^2 FE only	0.86	0.86	0.64	0.64	0.63	0.65
Adjusted R^2	0.86	0.86	0.64	0.64	0.63	0.65
N	51,313	51,313	51,313	169,255	169,255	169,255

Table 5: **Federal Funds Rate Passthrough on Deposit Spreads Rate Setting Branches**

Panel C: 2009-2020

	Dependent Variable: Δ Savings Rate Spread					
	At least 2 Counties			All		
	(1)	(2)	(3)	(4)	(5)	(6)
HHI x dFFR	0.02	0.03	0.02	0.02	0.01	0.02
	(1.34)	(1.36)	(0.55)	(1.03)	(0.95)	(1.17)
Bank-Qrt FE	Yes	Yes	No	No	No	No
State-Qrt FE	Yes	No	No	Yes	No	No
Branch FE	Yes	Yes	No	Yes	Yes	No
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Qrt FE	No	No	Yes	No	Yes	Yes
R^2 FE only	0.87	0.87	0.55	0.56	0.55	0.56
Adjusted R^2	0.87	0.87	0.55	0.56	0.55	0.56
N	79,080	79,080	79,080	263,074	263,074	263,074

Notes: This table reports OLS estimates from regressions described in equation (1). The dependent variables are the quarterly change in the annualized percentage deposit spreads. The coefficient of interest is the interaction of branch HHI and the quarterly change in the annualized Federal funds rate target. Deposit spreads are measured as the difference between the Federal funds rate and the branch deposit offer rate on $25K savings deposit accounts. HHI is the Herfindahl index that measures deposit market concentration in a county and is averaged over 1994-2013. The regressions include bank-quarter-, state-quarter-, branch-, county-, quarter, and county and post-2008 period fixed effect as indicated in the table. A "Rate-Setter" branch is defined as a branch that actively sets rates for itself and possibly for "follower" branches. These regressions include only rate-setting branches and require a bank to be active in at least two counties. Standard errors are clustered at the county level and t-statistics are reported below point estimates. The data is sourced from RateWatch and the FDIC covering 2001Q1 to 2013Q4 (Panel A), 2001Q1 to 2008Q4 (Panel B), and 2009Q1-2020Q2 (Panel C).

Table 6: **Deposit Spread Sensitivity to Monetary Policy: Rate Setter Results vs All Branches**

	Dependent Variable: Δ Savings Rate Spread							
	All Branches				Rate Setter			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
HHI x dFFR	-0.00	-0.02			0.07	0.06		
	(-0.29)	(-1.30)			(2.18)	(2.19)		
HHI x dFFR x 2 to 15 Counties			0.01	0.01			0.06	0.06
			(1.28)	(1.09)			(1.27)	(1.25)
HHI x dFFR x 16 to 35 Counties			0.02	0.02			0.18	0.20
			(0.73)	(0.82)			(2.10)	(2.45)
HHI x dFFR x more than 35 Counties			-0.02	-0.05			0.00	-0.00
			(-0.79)	(-1.62)			(0.07)	(-0.12)
Bank-Qrt FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-Qrt FE	Yes	No	Yes	No	Yes	No	Yes	No
Branch FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County X ZLB FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2 FE only	0.95	0.95	0.95	0.95	0.86	0.86	0.86	0.86
Adjusted R^2	0.95	0.93	0.95	0.93	0.86	0.86	0.86	0.86
N	1,765,860	1,765,860	1,765,860	1,765,860	87,770	87,770	87,770	87,770

Notes: This table reports OLS estimates from regressions described in equation (1). The dependent variables are the quarterly change in the annualized percentage deposit spreads. The coefficient of interest is the interaction of branch HHI and the quarterly change in the annualized Federal Funds rate target. Deposit spreads are measured as the difference between the Federal funds rate and the branch deposit offer rate on $25K savings deposit accounts. HHI is the Herfindahl index that measures deposit market concentration in a county and is averaged over 1994-2013. The regressions include bank-quarter-, state-quarter-, branch-, county-, quarter, and county and post-2008 period fixed effect as indicated in the table. A "Rate-Setter" branch is defined as a branch that actively sets rates for itself and possibly for "follower" branches. "All Branches" includes rate setter branches and follower branches into the regression sample. "Rate Setter" only includes rate-setting branches. All regressions require that a bank is active in at least two counties. The interactions "2 to 15 Counties", "16 to 35 Counties", and "more than 35 Counties" are indicators at the bank-year level for how many counties in which a bank operates its branches. Standard errors are clustered at the county level and t-statistics are reported below point estimates. The data is sourced from RateWatch and the FDIC covering 2001Q1 to 2013Q4.

Table 7: **Bank Flows and Monetary Policy: Placebo Tests**

Panel A: Deposit Flow and County Reach Placebo

	Dependent Variable: Δ Log Deposits					
	1994-2013		1994-2009		2010-2020	
	(1)	(2)	(3)	(4)	(5)	(6)
HHI x dFFR	-0.88		-1.13		0.64	
	(-3.16)		(-3.68)		(2.15)	
HHI x dFFR x 2-15 Counties		-1.58		-1.87		0.95
		(-4.31)		(-4.63)		(1.76)
HHI x dFFR x 16-35 Counties		-0.05		-0.14		-0.79
		(-0.08)		(-0.21)		(-0.77)
HHI x dFFR x >35 Counties		-0.47		-0.70		0.75
		(-1.18)		(-1.56)		(1.85)
Bank-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
State-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Branch FE	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes
County X ZLB FE	Yes	Yes	No	No	No	No
R^2 FE	0.27	0.27	0.31	0.31	0.22	0.22
Adjusted R^2	0.27	0.27	0.31	0.31	0.22	0.22
N	1,111,479	1,111,479	795,399	795,399	856,378	856,378

Panel B: Deposit Flow and Follower Placebo

	Dependent Variable: Δ log Deposit Flow					
	All 01-13	Flw 01-13	All 01-09	Flw 01-09	All 10-20	Flw 10-20
	(1)	(2)	(3)	(4)	(5)	(6)
HHI x dFFR	-0.44	-0.62	-0.77	-0.92	0.84	1.20
	(-1.54)	(-1.84)	(-2.50)	(-2.47)	(2.31)	(2.22)
Bank-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
State-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Branch FE	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes
County X ZLB FE	Yes	Yes	No	No	No	No
Adjusted R^2	0.26	0.26	0.31	0.32	0.22	0.21
N	856,671	609,826	540,891	352,995	855,867	666,035

Notes: This table reports regressions of the annual change in log branch-deposits. The variable of interest is the interaction of the change in the Federal funds rate (dFFR) with branch HHI. The regressions include bank-quarter-, state-quarter-, branch-, county-, and quarter fixed effect as indicated in the table. All regressions require that a bank is active in at least two counties. Sample periods are indicated in the columns. Deposit flows and bank-level geographic reach variables are calculated using data from the FDIC Summary of Deposits. The interactions "2 to 15 Counties", "16 to 35 Counties", and "more than 35 Counties" are indicators at the bank-year level for how many counties a bank is active in. Panel B relies in the distinction between rates setters and followers from the RateWatch dataset, available 2001-2020. "All" indicates all branches. "Flw" indicates follower branches. Standard errors are clustered at the county level and t-statistics are reported below point estimates.

Table 8: **Monetary Policy Pass-through and Market Definitions**

Panel A: All Banks

	Dependent Variable: Δ Savings Rate Spread			
	County	Zip	MSA	State
	(1)	(2)	(3)	(4)
HHI Cnty x dFFR	0.003			
	(0.67)			
HHI Zip x dFFR		0.004		
		(1.73)		
HHI MSA x dFFR			0.026	
			(1.62)	
HHI State x dFFR				0.003
				(0.06)
R^2 FE only	0.93	0.93	0.91	0.86
Adjusted R^2	0.93	0.93	0.91	0.86
N	278,105	271,245	74,732	19,465

Panel B: Large Reach Banks

	Dependent Variable: Δ Savings Rate Spread			
	County	Zip	MSA	State
	(1)	(2)	(3)	(4)
HHI Cnty x dFFR	-0.007			
	(-0.95)			
HHI Zip x dFFR		0.005		
		(1.42)		
HHI MSA x dFFR			0.011	
			(0.57)	
HHI State x dFFR				0.009
				(0.12)
R^2 FE only	0.92	0.91	0.89	0.83
Adjusted R^2	0.92	0.91	0.89	0.83
N	135,833	132,655	46,722	11,556

Notes: This table presents panel regressions of banks' deposit spread changes within various geographic market areas on changes in the Federal funds rate (dFFR) interacted with the HHI in the associated geographic market areas. The geographic HHI is an average over the sample period. For each market definition, we calculate the bank-market level value weighted offer rate. The considered geographic levels are Zip code, county (Cnty), metropolitan statistical area (MSA), and State. All regressions include bank-quarter, geographic-quarter, and branch fixed effects. The sample period is 2001 Q2 to 2008 Q4

Table 9: Market Power Measures and Market Valuation

	Dependent Variable: Market-to-Tier 1 Equity Ratio						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
HHI	-0.331					-0.387	
	(-1.01)					(-1.67)	
Rate Gap Flow Index		0.256					0.095
		(6.46)					(3.18)
Deposit Productivity			0.236		0.523	0.509	0.511
			(9.08)		(5.01)	(4.81)	(4.91)
Size				0.114	-0.206	-0.196	-0.206
				(6.12)	(-3.22)	(-3.02)	(-3.24)
ROE				1.496	1.476	1.483	1.432
				(7.93)	(8.04)	(8.05)	(7.75)
RWA/A				-0.377	-0.508	-0.526	-0.508
				(-1.46)	(-2.07)	(-2.13)	(-2.06)
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2 FE only	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Adjusted R^2	0.37	0.40	0.46	0.51	0.53	0.53	0.54
N	18,581	18,581	18,581	18,581	18,581	18,581	18,581

Notes: This table reports regression of bank stock market valuation multiples. The dependent variable is the ratio of market value of equity divided by Tier 1 capital. Bank-HHI is calculated as the deposit weighted average of the county-level HHIs in which that bank's branches operate, as in Drechsler, Savov, and Schnabl (2017). Rate Gap Flow Index is based on standardized "offer gaps" (difference between a branch offer rate and the average offer rate in that county) for both money market accounts and the 1-yr CD product, and branch deposit growth, with weights of 25%, 25%, and 50% respectively. Deposit Productivity is calculated as in Egan, Lewellen, and Sunderam (2022). Size is the log of assets. ROE is the trailing four quarters of net income divided by beginning of period Tier 1 capital. RWA/A is the ratio of risk-weighted assets to assets. Standard errors are clustered at the bank level and t-statistics are reported below point estimates. The sample period is from 2002 Q2 to 2020 Q1.

Table 10: **Deposit Channel: Alternative Market Power Measures**

Panel A: All Banks

	dSpread (1)	dLog D (2)	dLog L (3)	dSpread (4)	dLog D (5)	dLog L (6)	dSpread (7)	dLog D (8)	dLog L (9)
HHI x dFFR	0.07	-2.47	-1.70						
	(3.24)	(-2.90)	(-1.67)						
Flow Rate Gap x dFFR				0.01	0.01	-0.14			
				(1.52)	(0.03)	(-0.71)			
ELS Dep-Prd x dFFR							-0.03	0.09	-0.30
							(-5.16)	(0.87)	(-1.14)
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Qrt FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2 FE only	0.63	0.12	0.11	0.80	0.07	0.10	0.68	0.12	0.11
R^2	0.63	0.12	0.11	0.80	0.07	0.11	0.68	0.12	0.13
N	504,633	506,755	506,758	134,582	134,627	134,627	502,253	504,343	504,346

Panel B: Big Banks

	dSpread (1)	dLog D (2)	dLog L (3)	dSpread (4)	dLog D (5)	dLog L (6)	dSpread (7)	dLog D (8)	dLog L (9)
HHI x dFFR	0.02	2.30	-0.01						
	(0.46)	(2.43)	(-0.01)						
Flow Rate Gap x dFFR				-0.00	0.04	0.12			
				(-0.44)	(0.11)	(0.46)			
ELS Dep-Prd x dFFR							-0.03	-0.08	0.13
							(-3.54)	(-0.35)	(0.49)
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Qrt FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2 FE only	0.43	0.03	0.02	0.67	0.04	0.07	0.46	0.03	0.02
R^2	0.43	0.03	0.02	0.67	0.04	0.07	0.46	0.07	0.03
N	85,728	85,970	85,970	20,940	20,956	20,956	85,144	85,377	85,377

Notes: This table reports OLS estimates from regressions (as described in equation 2) of the change in the deposit spread (Column 1), deposit growth (Column 2), and loan growth (Column 3) for commercial banks. The deposit spread (Spread) is the difference between the Federal funds rate (FFR) and the interest rate on deposits, calculated as interest expense over previous period deposits. The variable of interest is the interaction of change in the FFR with bank market power measures. Bank-HHI is calculated as the deposit weighted average of the county-level HHIs in which that bank's branches operate, as in Drechsler, Savov, and Schnabl (2017). Rate Gap Flow Index is based on standardized "offer gaps" (difference between a branch offer rate and the average offer rate in that county) for both money market accounts and the 1-yr CD product, and branch deposit growth, with a weight of 25%, 25%, and 50% respectively. Deposit Productivity is calculated as in Egan, Lewellen, and Sunderam (2022). Big banks are the largest banks whose assets cumulate to 90%. The regressions include the main effect, and bank and time (quarter) fixed effects. Standard errors are clustered at the bank level and t-statistics are reported below point estimates. The sample is from 2001 to 2008.

Table 11: **Funding Source Substitution and the Deposit Channel**

	No Lags		w/ 4 Lags	
	Coefficient	adj R2 / N	Coefficient	adj R2 / N
Deposits				
1985Q1 - 2019Q4	0.107	-0.01	0.643	0.03
	(-0.37)	140	(-1.67)	140
1985Q1 - 2002Q2	0.177	-0.01	1.114	0.07
	(-0.49)	70	(-2.18)	70
2002Q3 - 2019Q4	-0.276	-0.01	-0.237	-0.01
	(-0.58)	70	(-0.41)	70
DC Deposits				
1985Q1 - 2019Q4	-2.298	0.17	-3.308	0.19
	(-5.34)	140	(-5.73)	140
1985Q1 - 2002Q2	-2.670	0.31	-3.869	0.36
	(-5.63)	70	(-5.79)	70
2002Q3 - 2019Q4	-1.790	0.05	-2.452	0.14
	(-2.19)	70	(-2.57)	70
NOT-DC Deposits				
1985Q1 - 2019Q4	1.902	0.14	2.638	0.16
	(-4.82)	140	(-4.97)	140
1985Q1 - 2002Q2	2.478	0.28	3.602	0.3
	(-5.30)	70	(-5.35)	70
2002Q3 - 2019Q4	0.726	0	1.156	0.03
	(-1.03)	70	(-1.36)	70

Table 11: **Funding Source Substitution and the Deposit Channel**

	No Lags		w/ 4 Lags	
	Coefficient	adj R2 / N	Coefficient	adj R2 / N
Debt				
1985Q1 - 2019Q4	1.590	0.02	2.960	0.04
	(-1.87)	140	(-2.58)	140
1985Q1 - 2002Q2	2.642	0.08	3.807	0.1
	(-2.66)	70	(-2.65)	70
2002Q3 - 2019Q4	0.394	-0.01	2.905	0.05
	(-0.27)	70	(-1.65)	70
Not DC Deposits + Debt				
1985Q1 - 2019Q4	1.857	0.13	2.77	0.17
	(-4.63)	140	(-5.19)	140
1985Q1 - 2002Q2	2.612	0.37	3.67	0.41
	(-6.46)	70	(-6.42)	70
2002Q3 - 2019Q4	0.563	-0.01	1.681	0.07
	(-0.72)	70	(-1.83)	70

Notes: This table presents regressions of percentage changes in aggregated commercial bank deposits, various components of deposits, and non-deposit debt on changes in the Federal funds rate (dFFR). Deposit channel (DC) deposits are defined as domestic deposits minus non interest paying domestic deposits minus domestic time deposits. Non-deposit channel deposits are defined as deposits minus DC deposits. Debt is defined as Federal funds purchased plus repo funding plus other borrowed money plus trading liabilities plus subordinated notes. The commercial bank data are from Call Reports FFIEC 031/041 over the period 1985 Q1 to 2019 Q4.

Table 12: Bank-County Deposit Flow Variation

Panel A: Stable Branch Flow

	Dependent Variable: Bank-County Flows		
	All Banks	Small Reach Banks	Large Reach Banks
	(1)	(2)	(3)
R^2 Year	0.01	0.01	0.01
R^2 Cnty-Year FE	-0.00	0.01	-0.00
R^2 Bank-Year FE	0.16	0.13	0.15
R^2 Bank-Year Cnty-Year FE	0.16	0.14	0.15
Deposit Share		0.24	0.60
Cdt Deposit Share	0.84	0.29	0.71
N	460,938	251,945	182,891

Panel B: All Branch Flow

	Dependent Variable: Bank-County Flows		
	All Banks	Small Reach Banks	Large Reach Banks
	(1)	(2)	(3)
R^2 Year	0.02	0.04	0.01
R^2 Cnty-Year FE	0.02	0.04	-0.00
R^2 Bank-Year FE	0.16	0.13	0.15
R^2 Bank-Year Cnty-Year FE	0.17	0.14	0.15
Deposit Share		0.24	0.60
Cdt Deposit Share	0.84	0.29	0.71
N	460,938	251,945	182,891

Notes: This table presents R^2s regressions of bank-county deposit flows on various fixed effects. The considered fixed effects are time (quarter), time-county, bank-county, and bank-county and time-county. Panel A presents the R^s of fixed-effect regressions for same-branch deposit flows and Panel B summarizes deposit growth rates including the addition and elimination of branches. Small (Large) Reach Banks are defined as banks active in 15 or fewer (more than 15) counties, excluding money center banks (as described in Section 2.3.The data are from the FDIC Summary of Deposit over the period 1994 to 2019.

Table 13: **County Deposit Flows and County Growth**

	(1)	(2)	(3)	(4)
Pop Growth (3 YR)	0.829			0.557
	(7.43)			(5.19)
Pop Growth (3 YR) x d3FFR	0.103			0.069
	(3.12)			(2.30)
Emp Growth (3 YR)		0.537		0.271
		(15.34)		(9.21)
Emp Growth (3 YR) x d3FFR		0.052		0.012
		(3.47)		(1.14)
GDP Growth (3 YR)			0.138	0.081
			(12.27)	(6.83)
GDP Growth (3 YR) x d3FFR			0.010	0.000
			(1.61)	(0.06)
State x Year	Yes	Yes	Yes	Yes
R^2 Only FE	0.14	0.14	0.14	0.14
Adjusted R^2	0.18	0.18	0.16	0.20
N	48,905	48,905	48,905	48,905

Notes: This table presents the results of panel regressions of three year county-level deposit flows on county level economic growth factors and their interaction with the change in the Federal funds rate over the same three years (d3FFR). Deposit flows are calculated as same-branch deposit growth using data from the FDIC Summary of Deposits. County-level economic variables include population growth, employment growth, and GDP growth (calculated from annual data from the BEA) and their interaction with d3FFR. The regressions include state and year fixed effects. Standard errors are clustered at the county and year level. The sample is from 2004 to 2019.

Table 14: **Bank Deposit Flows and Geographic Footprint Growth**

	Dependent Variable: Bank Level Deposit Flows								
	All			Small Reach Banks			Large Reach Banks		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VW County Deposit Flows	0.50			0.49			0.95		
	(13.96)			(13.81)			(11.42)		
Population Predicted County Deposit Flows		0.62			0.61			1.81	
		(5.26)			(5.17)			(2.86)	
GDP Predicted County Deposit Flows			0.57			0.55			1.63
			(4.22)			(4.07)			(2.86)
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.19	0.16	0.16	0.19	0.16	0.16	0.18	0.08	0.11
N	226,629	214,206	141,160	222,870	211,271	138,889	3,719	2,907	2,243

Notes: This table presents panel regressions of bank level deposit flows on the average growth within the "footprint" of bank's geographic range of its branch network. We consider three measures of footprint growth, including actual deposit growth, deposit growth predicted by population growth, and deposit growth predicted by GDP growth. The predicted deposit growth for each county comes from regressions of county growth on county population growth or GDP growth. Each bank's footprint is calculated as the deposit weighted average deposit growth (or predicted deposit growth) across the counties in which the bank operates branches. The regressions include bank fixed effects. Standard errors are clustered at the bank and year level. The sample is from 2001 to 2019.

Appendix A Additional results and robustness

A.1 Deposit Rates and Bank Characteristics

We explore the determinants of average rates with regressions of bank average offer rates on a variety of bank characteristics. Table A1 presents results for certificates of deposits with a minimum balance of $10,000 of 12-month term. All regressions include quarter fixed effects, and have standard errors calculated with bank and time clustering.

Large banks those active in numerous counties, and banks more exposed to large reach banks (in line with Proposition 2 of Park and Pennacchi (2008)) offer lower retail deposit rates. Banks with stronger deposit growth offer higher rates. These are statistically significant effects, but the economic magnitudes are modest. Additionally, these characteristics contribute little incremental explanatory power to the time fixed effects, as adjusted R^2s are essentially unchanged relative to those with fixed effects alone.

A one-standard deviation increase in log asset size reduces CD rates by 6 bps (4% of its standard deviation). A one standard deviation increase in the log of number of counties a bank operates in decreases CD rates by 6 bps. Banks with higher average deposit growth rates pay more: a one standard deviation increase in 5-year average deposit growth is associated 6 bps increase in CD rates. After controlling for size, county reach, and deposit growth, being exposed to a large reach bank reduces rates on CD accounts by 3 bps. Using the same controls as above, a one-standard deviation move in the branch footprint's population growth increases the rate paid CDs by 2 bps. Note that these effects are average annual effects.

A.2 Where is rate setter result located?

We investigate which small subset of rate-setting branches sets rates more sluggishly in more concentrated deposit markets. Considering our summary statistics in Section 2.3 it is clear that very small banks have no scope to engage in differentiated geographic deposit pricing, while the largest banks with scope are not doing it. Since scope to exploit geographic market power depends on the number of counties a bank is active in, we slice the deposit spread rate location by conducting a grid-search over the number of counties. Specifically, we count the number of distinct counties per year for each of the banks in the SOD data and group banks into county buckets. We then run the DSS specification of branch (b) level quarterly (t) changes in deposit spreads on the interaction of the change in the target Federal Funds Rate with the county's c HHI and a bank-year indicator that turns one when the bank is active in a specific number of counties or 0 otherwise. We also include the full set of fixed effects of the preferred DSS specification, i.e., bank-quarter, state-quarter, branch, county, and county-zero-lower bound fixed effects.[29]

$$
\begin{aligned}
(\Delta \text{FFR}_t - \Delta r^{sav}(b,i,c,s,t)) = & \lambda_1(i,t) + \lambda_2(s,t) + \lambda_3(b) + \lambda_4(c) + \lambda_5(c,p10) \\
& + \gamma\left[\Delta \text{FFR}(t) \times \text{county-HHI}(i) \times \text{Cnty-Nbr-grid}_{i,y}\right] + e_{b,t}.
\end{aligned}
\tag{4}
$$

We report the results for rate-setters in Appendix Tables A2-A4. Column (1) across all tables (except Panel B of Table A2) replicates the DSS rate setter specification for comparison. Appendix Tables A2 investigates banks active in 2 to 10, 5 to 15, 10 to 20, etc up to 35 to 45 counties. Appendix Tables A3 studies banks active in 5 to 20, 10 to 25, and so on up to 35 to 50 counties in panel A and 5 to 25, 10 to 30, and so on up to 35 to 55 counties in panel B. Appendix Tables A4 studies banks active in 5 to 30 up to 35 to 60 in panel A and 5 to 35 up to 35 to 65 counties in panel B. A clear pattern emerges in that the rate setter result is very localized in banks that reach around 10 to 30 or 15 to 35 counties. The strongest effect, a coefficient of 0.35 with a Tstat of 2.65 can be seen in the subset of banks that is active in 25 to 35 counties (Table A2, Column 7). Banks in this category are moderately large regional banks, such as Citizens Bank of Pennsylvania and Texas, UMB Bank, and the Bank of Oklahoma. But their deposit market share does not exceed 4% on average.

[29]DSS 2017 mention the use of the county-zero-lower bound fixed effect on page 1848 of the publication and in the replication code specification for both the spread and the flow regressions.

Table A1: **How Do Banks Set Rates? Certificates of Deposits**

Panel B: Certificate of Deposit Rates

	Dependent Variable: Rate Level cd					
	(1)	(2)	(3)	(4)	(5)	(6)
Log Assets	-0.045					-0.033
	(-9.62)					(-6.27)
Log Counties		-0.068				-0.032
		(-13.19)				(-5.80)
Deposit Growth (5yr avg)			0.004			0.005
			(8.08)			(13.21)
Exposure to Large Reach Banks				-0.170		-0.196
				(-5.14)		(-8.52)
Pop. Growth (5yr avg) of Footprint					0.016	0.023
					(2.71)	(5.60)
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
R^2 just FE	0.91	0.91	0.91	0.91	0.91	0.91
R^2	0.91	0.91	0.91	0.91	0.91	0.92
N	405,892	405,892	405,892	405,892	405,892	405,892

Notes: This table presents cross-sectional regressions of bank and quarter level offer rates for 12-month certificate of deposits. Log Assets are logged total assets. Log counties is the number of counties in which the bank has its branches. Deposit growth (5yr avg) is a bank's 5-year deposit growth. Exposure to Large Reach Banks is calculated as follows: for each county and year, we compute the share of large reach banks, i.e., those active in more than 15 counties, in terms of numbers and deposits and average across the two. We then form an equal weighted average across counties for each bank and year. Population Growth (5yr avg) is a bank level average over its counties' population growth, computed as the geometric average over five years for each county the bank has branches in. The regression include quarter (time) fixed effects. Standard errors are clustered by bank and quarter.

Table A2: **Grid Search step 10 and all branches**

Panel A: Rate Setter Grid step size 10

	Dependent Variable: Δ Savings Rate Spread 94-13								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
HHI x dFFR	0.07 (2.14)								
HHI x dFFR x 2 to 10 Counties		0.05 (1.08)							
HHI x dFFR x 5 to 15 Counties			0.14 (1.65)						
HHI x dFFR x 10 to 20 Counties				0.13 (1.12)					
HHI x dFFR x 15 to 25 Counties					0.10 (0.84)				
HHI x dFFR x 20 to 30 Counties						0.19 (1.25)			
HHI x dFFR x 25 to 35 Counties							0.35 (2.65)		
HHI x dFFR x 30 to 40 Counties								0.10 (1.36)	
HHI x dFFR x 35 to 45 Counties									-0.02 (-0.35)
Adjusted R^2	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
N	87,763	87,763	87,763	87,763	87,763	87,763	87,763	87,763	87,763

Panel B: All Branch Result

	Dependent Variable: Δ Savings Rate Spread 94-13			
	(1)	(2)	(3)	(4)
HHI x dFFR	-0.00 (-0.29)			
HHI x dFFR x 25 to 35 Counties		-0.00 (-0.02)		
HHI x dFFR x 5 to 35 Counties			0.01 (1.07)	
HHI x dFFR x 10 to 30 Counties				-0.00 (-0.00)
Adjusted R^2	0.95	0.95	0.95	0.95
N	1,765,860	1,765,860	1,765,860	1,765,860

Notes:This table presents OLS regressions of the logged change in branch level deposits on the interaction of the change in the federal funds rate and the county deposit Herfindahl index (HHI). We include bank-year, state-year, branch, county, and county zero Standard errors are clustered at the county level.

Table A3: **Grid Search step 15-20**

Panel A: Grid step size 15

	Dependent Variable: Δ Savings Rate Spread 94-13							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
HHI x dFFR	0.07 (2.14)							
HHI x dFFR x 5 to 20 Counties		0.11 (1.59)						
HHI x dFFR x 10 to 25 Counties			0.13 (1.40)					
HHI x dFFR x 15 to 30 Counties				0.14 (1.23)				
HHI x dFFR x 20 to 35 Counties					0.22 (1.74)			
HHI x dFFR x 25 to 40 Counties						0.14 (1.84)		
HHI x dFFR x 30 to 45 Counties							0.09 (1.29)	
HHI x dFFR x 35 to 50 Counties								-0.07 (-0.87)
Adjusted R^2	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
N	87,763	87,763	87,763	87,763	87,763	87,763	87,763	87,763

Panel B: Grid step size 20

	Dependent Variable: Δ Savings Rate Spread 94-13							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
HHI x dFFR	0.07 (2.14)							
HHI x dFFR x 5 to 25 Counties		0.12 (1.82)						
HHI x dFFR x 10 to 30 Counties			0.15 (1.71)					
HHI x dFFR x 15 to 35 Counties				0.17 (1.65)				
HHI x dFFR x 20 to 40 Counties					0.14 (1.57)			
HHI x dFFR x 25 to 45 Counties						0.13 (1.78)		
HHI x dFFR x 30 to 50 Counties							0.03 (0.48)	
HHI x dFFR x 35 to 55 Counties								-0.06 (-0.90)
Adjusted R^2	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
N	87,763	87,763	87,763	87,763	87,763	87,763	87,763	87,763

Table A4: **Grid Search step 25 to 30**

Panel A: Grid step size 25

	Dependent Variable: Δ Savings Rate Spread 94-13							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
HHI x dFFR	0.07 (2.14)							
HHI x dFFR x 5 to 30 Counties		0.13 (2.08)						
HHI x dFFR x 10 to 35 Counties			0.17 (2.06)					
HHI x dFFR x 15 to 40 Counties				0.12 (1.54)				
HHI x dFFR x 20 to 45 Counties					0.14 (1.55)			
HHI x dFFR x 25 to 50 Counties						0.07 (1.07)		
HHI x dFFR x 30 to 55 Counties							0.03 (0.44)	
HHI x dFFR x 35 to 60 Counties								-0.06 (-0.86)
Adjusted R^2	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
N	87,763	87,763	87,763	87,763	87,763	87,763	87,763	87,763

Panel B: Grid step size 30

	Dependent Variable: Δ Savings Rate Spread 94-13							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
HHI x dFFR	0.07 (2.14)							
HHI x dFFR x 5 to 35 Counties		0.14 (2.37)						
HHI x dFFR x 10 to 40 Counties			0.14 (1.94)					
HHI x dFFR x 15 to 45 Counties				0.11 (1.52)				
HHI x dFFR x 20 to 50 Counties					0.10 (1.22)			
HHI x dFFR x 25 to 55 Counties						0.07 (1.03)		
HHI x dFFR x 30 to 60 Counties							0.03 (0.43)	
HHI x dFFR x 35 to 65 Counties								-0.06 (-0.89)
Adjusted R^2	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
N	87,763	87,763	87,763	87,763	87,763	87,763	87,763	87,763

Table A5: **Market Power Index XS Regressions**

	Dependent Variable: Market Power Index						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Bank HHI	-0.13						-0.11
	(-6.63)						(-5.45)
Core Deposit Spread Beta		-0.01					-0.00
		(-3.55)					(-1.36)
Log Deposits			0.02				0.01
			(6.97)				(2.58)
ROE				0.04			0.02
				(1.44)			(0.79)
Nbr. Cnty (hundreds)					0.13		0.11
					(8.01)		(4.88)
Nbr. Cnty (hundreds) Sqr					-0.01		-0.01
					(-3.81)		(-2.39)
Nbr. MM Rates						-0.00	-0.01
						(-0.54)	(-2.96)
Nbr. CD Rates						0.01	0.00
						(4.19)	(1.20)
Five-Year Period FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2 FE only	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Adjusted R^2	0.02	0.01	0.02	0.01	0.02	0.01	0.02
N	10,226	10,226	10,226	10,226	10,226	10,226	10,226

Notes: This table presents panel regresions using commercial bank-year level observations of market power index on explanatory variables. Market power index is constructed as a Z-score of XXX. Explanator variables include the lag market power, bank