Bank Monopsony Power and Deposit Demand

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Abstract

Households exhibit "return chasing" behavior, so through asset reallocation channel, good stock market performance induces contractions in deposit supply. Using stock market performance as a shock to deposit supply, we trace banks' deposit demand and identify the relationship between bank market power and the slope of deposit demand. Exploiting a fixed effects identification strategy by comparing branches with the same parent bank located in different cities within the same county, we find that bank market power makes deposit demand curve steeper. Steeper deposit demand curve attenuates the spillover effects on the local deposit market of stock market fluctuations. Counties with more bank market power also experience less contractions in small business lending when stock market performance is good. Overall, our results suggest that bank market power is important in insulating and stabilizing local deposit and lending market from the spillover effects of the stock market.

JEL classification: G11, G21, G41, G51

Keywords: Market Power, Banks' Deposit Demand, Stock Market, Spillover Effects

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1 Introduction

We trace banks' deposit demand curve using stock market performance as a shock to deposit supply. We answer a fundamental question on market power using data from the deposit market: does bank monopsony power make deposit demand curve steeper?[1] Our results suggest that bank market power indeed steepens the deposit demand curve, which also attenuates the spillover effects on the deposit market of the stock market. When stock market performance is good, households tend to reallocate capital from the deposit market to the stock market, which induces contractions in deposit supply. Using a fixed effects identification strategy by comparing branches of the same bank located in different cities within the same county, we show that in response to deposit supply contractions, branches located in more concentrated cities experience less deposit contractions, compared with branches with the same parent bank located in less concentrated cities within the same county.

Our results are important for three reasons. First, by providing causal evidence on the relationship between bank market power and deposit demand, our study complements the structural studies trying to recover the preference parameters and quantify the effects of imperfect competition in the deposit market (e.g., Egan, Hortaçsu, & Matvos, 2017; Wang, Whited, Wu, & Xiao, 2022).

Second, the mechanism we pin down shows that bank market power interacts with different types of deposit supply changes differently. We show that bank market power makes deposit demand curve steeper, and steeper deposit demand curve attenuates the effects of supply curve contractions. This mechanism complements the deposit channel of monetary policy by Drechsler, Savov, and Schnabl (2017), who show that bank market power amplifies the effects of supply contractions when rising interest rate makes deposit supply inelastic. This finding is important as it sheds light on the opposite effects of bank market power under different conditions, which poses new dimensions and challenges for regulators.

Third, we show that bank market power stabilizes local deposit market. The importance of this finding can be evidenced by the catastrophic consequences of the Great Financial Crisis. Banks are the largest financial institutions and U.S. banks hold nearly \$20 trillions assets,[2] of which more than 80% are funded by deposits. Given the systemic roles of banks and the size of the deposit market, deposit market stability is critical for financial system stability, which has been documented and studied extensively (e.g., Acharya & Mora, 2015; Cornett, McNutt, Strahan, & Tehranian, 2011; Diamond & Dybvig, 1983; Goldstein

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[1] We use the word "monopsony" to emphasize that banks are defined as the demand side in our study, throughout the paper we use "monopsony power" and "market power" interchangeably to refer bank market power in the deposit market.

[2] https://www.statista.com/statistics/188627/us-chartered-commercial-bank-financial-assets/

& Pauzner, 2005; Ivashina & Scharfstein, 2010; Iyer & Puri, 2012, to name a few). Our study on the relationship between bank market power and deposit demand is important in evaluating the net effects on the deposit market of deposit supply fluctuations.

Figure 1 plots the time series of core deposit growth rate (aggregate deposit growth rate, solid line) and 12-month lagged Sharpe ratio of the S&P 500 index (dashed line) from 1982 to 2019. The core deposit is measured as the sum of Saving Deposits, Small Time Deposits, and Checkable Deposits using the time series data from Federal Reserve Economic Data (FRED) following Drechsler et al. (2017). It shows a significant negative correlation between the two series (lagged Sharpe ratio of the S&P 500 index explains 14% of variation in the aggregate deposit growth rate, and the value of the regression coefficient indicates that a 1 standard deviation increase in lagged Sharpe ratio is associated with 1.32% lower deposit growth rate, which is around 23% of average deposit growth rate in the sample period). Recent studies argue that the negative correlation between the two series is driven by household asset reallocation behavior from the deposit market to the stock market (Farrell & Eckerd, 2021; Lin, 2020). These studies suggest that recent past stock market performance is an effective shock to household deposit supply. Based on their studies, we use stock market performance as a shock to deposit supply to trace out banks' deposit demand curve, and show that bank market power steepens deposit demand.

[Insert Figure 1 around here]

Figure 2 visualizes our main findings. We collect city level deposit quantity and branch level deposit rate data, and construct city level deposit growth and Herfindahl index. Then for each year t, we sort all cities into 10 deciles based on previous year's Herfindahl index. Finally for each decile of cities, we conduct the following two regressions:

$$\begin{aligned} \Delta Dep_{mgt} &= \alpha_m + \beta_g^q SR_{t-1} + \varepsilon_{mgt} \\ \Delta APY_{klgt} &= \alpha_{kl} + \beta_g^p SR_{t-12} + \varepsilon_{klgt}, \end{aligned} \tag{1}$$

where m indexes city; k indexes branch; l indexes deposit product; g indexes HHI decile; and t indexes year in the quantity equation (the first equation) and month in the price equation (the second equation). ΔDep_{mgt} is the log deposit growth rate in city m from year $t-1$ to year t; SR_{t-1} is the Sharpe ratio of the S&P 500 index in year $t-1$; ΔAPY_{klt} is the change in the annual percentage yield of deposit product l provided by branch k from month $t-12$ to month t; SR_{t-12} is the Sharpe ratio of the S&P 500 index from month $t-24$ to month $t-12$; α_m stands for city fixed effects; and α_{kl} stands for branch×product fixed effects. We plot the regression coefficients (β_g^q, β_g^p) from Equation 1 against HHI decile g in Figure 2.

The solid line connects the quantity sensitivity coefficients and the dashed line connects the price sensitivity coefficients.

[Insert Figure 2 around here]

From Figure 2 we can verify two points. First, all quantity coefficients are negative except the coefficient in the most concentrated decile, and all price coefficients are positive. These results suggest that lagged Sharpe ratio moves quantity and price in the opposite directions, which confirms that stock market performance captures a deposit supply shock.

Second, we can see that the quantity coefficient is monotonic increasing in HHI decile, and the price coefficient also exhibit an increasing pattern in HHI decile. These results suggest that in response to negative deposit supply shocks, the most concentrated cities experience the least quantity contractions but the most price increase. These patterns are consistent with the hypothesis that bank market power makes deposit demand curve steeper, which attenuates the effects on quantity but amplifies the effects on price of supply shiftings. We conduct various tests to pin down the relationship between bank market power and the slope of deposit demand.

We address two identification challenges to pin down the relationship between bank market power and the slope of deposit demand curve, namely heterogeneous supply shiftings and heterogeneous demand shiftings. To rule out the possibility that our results are driven by heterogeneous supply shiftings, which are likely to be true when bank market power is correlated with local demographics that can induce heterogeneous responses to stock market performance, we first conduct city level analysis with county×year fixed effects and show that more concentrated cities experience less deposit growth contractions, compared with less concentrated cities within the same county. This evidence suggests that our results cannot be explained by any time-varying and time-invariant county level demographics that can shift deposit supply curve heterogeneously (e.g., stock market participation rate as documented by Lin, 2020). Quantitatively, our results suggest that a 1 standard deviation increase in lagged Sharpe ratio is associated with 0.53% lower city level deposit growth rate (or 15% of the average city deposit growth rate), and cities with 1 standard deviation above the mean HHI level experience 0.11% less deposit growth contractions, compared with cities with the mean HHI level within the same county.

Then we augment our results by conducting price analysis and showing that in response to supply contractions, more concentrated cities with less deposit growth contractions experience more price increase, compared with less concentrated cities within the same county. This evidence suggests that our results are unlikely to be driven by heterogeneous supply shiftings, as heterogeneous supply shiftings hypothesis would predict less contractions in quantity to be associated with less, instead of more, price increase.

To rule out the possibility that our results are driven by heterogeneous demand shiftings, which can be true when bank market power is correlated with local demand shiftings, we use a similar identification strategy as in Drechsler et al. (2017) by comparing different branches within the same bank. However, instead of using a widely used specification in the banking literature with bank×year fixed effects (e.g., Jiménez, Ongena, Peydró, & Saurina, 2012, 2014; Peydró, Polo, & Sette, 2021, to name a few), we impose a more restrictive specification with bank×county×year fixed effects. In our research setting, the identifying assumption behind a bank×year fixed effects specification is that banks can allocate capital across all areas where they operate to equalize lending opportunities, while a bank×county×year fixed effects specification only assumes that banks can allocate capital across different areas within the same county. This more restrictive specification further alleviates the concern that banks' internal capital market can be segmented geographically, which threats the identifying assumption behind a bank×year fixed effects specification. For example, regulations of local bank entities, decentralized operations of banks, and asymmetric information in the lending market can all potentially segment banks' internal capital market geographically. Quantitatively, our results suggest that a 1 standard deviation increase in lagged Sharpe ratio is associated with 0.53% lower branch level deposit growth rate (or 6.7% of the average branch deposit growth rate), and branches located in cities with 1 standard deviation above the mean HHI level experience 0.09% less deposit growth contractions, compared with branches with the same parent bank located in cities with the mean HHI level within the same county.

Finally, we provide some evidence showing that stock market fluctuations also have spillover effects on small business lending in the local market. Overall, our results suggest that bank market power steepens the deposit demand curve and attenuates the spillover effects of the stock market on both the local deposit and lending market.

Related Literature. Our paper contributes to several strands of literature on banking and industrial organization. This paper first contributes to the literature on bank competition in the deposit market, and Drechsler et al. (2017) is the closest paper. Compared with Drechsler et al. (2017), we make two contributions. Empirically, we trace out the relationship between bank market power and deposit demand curve and show that bank market power steepens deposit demand curve, while Drechsler et al. (2017) identify banks' pricing behavior when deposit supply becomes inelastic. Theoretically, we show that market power interacts with different types of supply changes differently. We show that bank market power attenuates the effects of supply contractions, while Drechsler et al. (2017) show that bank market power amplifies the effects of supply contractions when supply becomes inelastic.

Other studies on bank competition in the deposit market are focused on quantifying the effects of competition through the lens of calibration or structural estimation (Corbae & D'Erasmo, 2021; Corbae & D'Erasmo, 2020; Dick, 2008; Egan et al., 2017; Granja & Paixao, 2019; Martinez-Miera & Repullo, 2010; Tanner, Zanzalari, Manion, & Haavind-Berman, 2021; Wang et al., 2022), we contribute to this literature by providing causal evidence on the relationship between bank market power and the slope of deposit demand curve, which complements their quantitative findings.

The second strand of literature we contribute to is the literature on deposit pricing. This strand of literature focuses on the role of market power in monetary policy transmission and finds that deposit rate is sticky and market power slows the adjustments of deposit rate following interest rate changes (Berger & Hannan, 1989; Diebold & Sharpe, 1990; Driscoll & Judson, 2013; Duquerroy, Matray, & Saidi, 2020; Hannan & Berger, 1991; Neumark & Sharpe, 1992; Yankov, 2014). In these studies, interest rate changes unavoidably affect lending rate and funding cost simultaneously. Using stock market performance as a supply shock, which has less mechanic effects on the deposit and lending rate, we find that market power gives more freedom to banks and the deposit rates in more concentrated areas are more responsive to deposit supply conditions.

Finally, this study contributes to the broad literature on the deposit market and banking. This strand of literature includes studies on factors driving deposit flows, and the most related papers from this literature are Machlup (1940), Lin (2020), and Farrell and Eckerd (2021). Machlup (1940) provides a theoretical discussion of the deposit and stock market in the cyle, while Lin (2020) and Farrell and Eckerd (2021) provide empirical evidence showing that stock market performance is the cause of household capital reallocation decisions and deposit withdraws.[3] Based on their studies, our study exploits stock market performance as a shock to deposit supply to trace out banks' deposit demand curve. Other papers in this strand of literature try to pin down different factors in driving deposit flows (Q. Chen, Goldstein, Huang, & Vashishtha, 2022; Q. Chen, Vashishtha, & Wang, n.d.; Y.-C. Chen, Hung, & Wang, 2022; Flynn & Wang, 2022; Levine, Lin, Tai, & Xie, 2021; X. Li & Ye, 2022; Lin, 2021; Martinez Peria & Schmukler, 2001) and bank runs (Diamond & Dybvig, 1983; Goldstein & Pauzner, 2005; Iyer & Puri, 2012; Iyer, Puri, & Ryan, 2016; Kelly & O Grada, 2000; Schumacher, 2000; White & Ó Gráda, 2003), or more broadly study the roles of deposit in banking and lending (Acharya & Mora, 2015; Becker, 2007; Bernanke & Blinder, 1988; Bernanke, Blinder, et al., 1992; Cornett et al., 2011; Drechsler, Savov, & Schnabl, 2021, 2022;

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[3] Andonov and Rauh (2020); Greenwood and Shleifer (2014); Warther (1995) also document that there is a positive relationship between stock returns and money flows into the stock market. Although these are not studies on the deposit market, they provide evidence showing investor behavior in response to stock market performance.

Duquerroy, Matray, & Saidi, 2022; Gatev, Schuermann, & Strahan, 2009; Gilje, Loutskina, & Strahan, 2016; Heider, Saidi, & Schepens, 2019; Ivashina & Scharfstein, 2010; Kashyap, Rajan, & Stein, 2002; L. Li, Loutskina, & Strahan, 2019; Parra, 2016; Plosser, 2014), We contribute to this literature by providing evidence on how local bank market power interacts with deposit withdraws.

The rest of the paper is organized as follows: Section 2 describes the data, summary statistics, and construction of key measures of bank market power. Section 3 discusses our identification strategy and the main results on bank market power and deposit demand. Section 4 presents other related results. And Section 5 concludes.

2 Data and Summary Statistics

The main data used in our analysis are combined from four sources: (1) aggregate time series data from Bloomberg and Federal Reserve Economic Data (FRED); (2) deposit amount data from Federal Deposit Insurance Corporation (FDIC); (3) Rate-Watch deposit rate data from S&P Global Market Intelligence; (4) small business lending data from Community Reinvestment Act (CRA).

Aggregate Time Series. The S&P 500 index return we use is the monthly return series from Bloomberg, and we compute Sharpe ratio using twelve month rolling window as the Sharpe ratio of by the end of current month.

The Fed Funds Rate is the FEDFUNDS series from the FRED. The Fed Funds Rate is available at the monthly frequency. We compute the YoY change in the Fed Funds Rate as twelve month change in the Fed Funds Rate.

Aggregate deposit amount is defined as the Core Deposits in Drechsler et al. (2017), which is the sum of Saving Deposits, Small Time Deposits, and Checkable Deposits. These variables correspond to SAVINGS, STDSL, and TCD series from the FRED, respectively. These aggregate measures are available at weekly frequency. To compute the YoY deposit growth rate, we keep the last observation in each month as the month end deposit amount, and compute twelve month deposit growth as the YoY deposit growth rate.

As FRED stops publishing saving deposits (SAVINGS) from May 2020, small time deposits (STDSL) from Dec 2021 and checkable deposits (TCD) from March 2021, the aggregate time series data covers from 1982 to 2019.

FDIC Deposit Amount Data. The branch level deposit amount data comes from the FDIC, which covers from 1994 to 2019 to be consistent with the aggregate data. 1994 is the first year the data is available electronically. Since we need to compute yearly deposit growth rate, the final deposit growth data is available from 1995 to 2019.

The branch level deposit data are used to construct different levels of deposit growth data, including (1) city level deposit growth data; (2) county level deposit growth data; (3) bank-city level deposit growth data; and (4) bank-county level deposit growth data.

Rate Watch Deposit Rate Data. The branch level deposit rate data comes from Rate-Watch of the S&P Global Market Intelligence. The data we get from Rate-Watch covers from 2001 to 2019.[4] Following Drechsler et al. (2017), we also focus on branches actively setting deposit rates. The deposit rate data contain rates by products, our analysis focuses on the most common 20 products, including 16 certified deposit products (10K and 100K deposit products with maturity of 3 month, 6 month, 12 month, 18 month, 24 month, 36 month, 48 month, and 60 month, respectively), and 4 money market products (10K, 25K, 50K, and 100K money market account).[5] Rate-Watch collects weekly branch-level deposit rates. We first aggregate the data into monthly×branch×product level data by averaging annual percentage yield (APY) for each deposit product provided by each branch within each month, then we construct the 12 month rolling changes in annul percentage yield for each product provided by each branch.

CRA Small Business Lending Data. The small business lending data comes from FFIEC Community Reinvestment Act, which covers from 1996 to 2019. 1996 is the first year the data is available. CRA provides number of loans and loan amount originated in each county classified by loan amount at origination. We construct aggregate number of loans and loan amount by summing up number of loans and loan amount across all categories.

Measures of Market Power. We construct market power measures, specifically Herfindahl index, at both city and county level. As we are interested in local market competition, we try to define market as granular as possible so the competition is as relevant as possible, and our main measure of market power is at the city level.[6] We first construct city level HHI using following formula:

$$HHI_{mt} = \sum_{i \in \mathcal{I}(m)} \left(\frac{Dep_{imt}}{\sum_{i \in \mathcal{I}(m)} Dep_{imt}} \right)^2 , \tag{2}$$

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[4] We communicated with the agent at Rate-Watch when we purchased the data, as we also wanted to get the data from 1994, but the agent told us the earliest data available is from 2001 as of the time we purchased.

[5] In Rate-Watch data, these products are identified by 03MCD10K, 03MCD100K, 06MCD10K, 06MCD100K, 12MCD10K, 12MCD100K, 18MCD10K, 18MCD100K, 24MCD10K, 24MCD100K, 36MCD10K, 36MCD100K, 48MCD10K, 48MCD100K, 60MCD10K, 60MCD100K, MM10K, MM25K, MM50K, and MM100K, respectively.

[6] For example, the size of Los Angeles county is 12,310 km^2 and the population is near 10 millions. Within Los Angeles county, the distance between Lancaster and Long Beach is over 90 miles. Given the size and population of Los Angeles county, branches and banks in Lancaster are unlikely to be relevant competitors of branches and banks in Long Beach.

where i indexes entity (branch or bank); m indexes city; and t indexes year. Dep_{imt} is the deposit amount of entity i in city m at the end of year $t-1$; and $\mathcal{I}(m)$ is the set of all entities in city m. Using this formula, we construct both branch-city and bank-city HHI.

We construct county level HHI using following formula:

$$HHI_{nt} = \sum_{m \in \mathcal{M}(n)} \frac{Dep_{mt}}{Dep_{nt}} \times HHI_{mt}, \tag{3}$$

where m indexes city; n indexes county; and t indexes year. Dep_{mt} and Dep_{nt} are the deposit amount in city m and county n at the end of year t, respectively; HHI_{mt} is the Herfindahl index in city m at the end of year t; and $\mathcal{M}(n)$ is the set of all cities in county n. Using this formula, we construct both branch-county and bank-county HHI.

We construct county level HHI as the weighted average city level HHI of cities within the same county. We construct county level HHI this way for the same reason that we want to measure relevant competition at local level. For example, suppose there are two counties, County 1 and County 2, both of which comprise of two cities. County 1 comprises of City A and City B, while County 2 comprises of City C and City D. Two banks, Bank 1 and Bank 2, simultaneously operate in both County 1 and County 2. Bank 1 has two branches in City A, one branch in City C, and one branch in City D, while Bank 2 has two branches in City B, one branch in City C, and one branch in City D. Effectively, Bank 1 has monopsony power in City A and Bank 2 has monopsony power in City B, while Bank 1 and Bank 2 form duopoly market structure in both City C and City D. However, if we construct HHI directly at the county level, County 1 and County 2 would have the same HHI.[7]

Summary Statistics. We present summary statistics of key variables used in our empirical analysis in Table 1. For different levels of deposit observations, we construct variable Size as the logarithm of deposit amount at the corresponding observation level.

Panel A of Table 1 presents the summary statistics for monthly aggregate time series of lagged Sharpe ratio (LSR) and change in the Fed Funds Rate (FF).

Panel B of Table 1 presents the summary statistics for yearly city level deposit amount and HHI measures. The average deposit growth rate is 3.9% and the average deposit amount is \$ 437 millions. For comparison, Panel C of Table 1 presents the summary statistics for

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[7] We also conduct county level analysis using following county level HHI:

$$HHI_{mt} = \sum_{i \in \mathcal{I}(m)} \left(\frac{Dep_{imt}}{\sum_{i \in \mathcal{I}(m)} Dep_{imt}} \right)^2,$$

where i indexes entity (branch or bank); m indexes county; and t indexes year. Dep_{imt} is the deposit amount of entity i in county m at the end of year $t-1$; and $\mathcal{I}(m)$ is the set of all entities in county m, and the results are qualitatively the same.

yearly county level deposit amount and HHI measures. The average deposit growth rate is 3.2% and the average deposit amount is $ 2,100 millions. The average county market size is about 5 times of city market size.

Panel D of Table 1 presents the summary statistics for yearly branch level deposit amount data. This is the data we use in our most restrictive identification specification with bank× county×year or bank×state×year fixed effects to address heterogeneous supply shiftings and demand shiftings simultaneously. The average deposit growth rate is 7.9% and the average deposit amount is $ 79 millions.

Panel E of Table 1 presents the summary statistics for yearly bank-city level deposit amount data and Panel F of Table 1 presents the summary statistics for yearly bank-county level deposit amount data. These are data we use for robustness checks. The average deposit growth rate is 7.6% at the bank-city level and 7.9% at the bank-county level.

Panel G of Table 1 presents the summary statistics for monthly branch level deposit rate data from Rate-Watch. The key variable of interest here is the 12 month rolling change in annual percentage yield of deposit products (DAPY). The average change in annual percentage yield is -0.122%.

Panel H of Table 1 presents the summary statistics for yearly county level small business lending data. The two key variables are are logarithm of 1 plus small business loan amount (LoanAmt) and logarithm of 1 plus number of small business loans (LoanNum).[8]

[Insert Table 1 around here]

3 Identification Strategy and Main Findings

To establish the causal link between bank market power and the slope of deposit demand, theoretically, we need an exogenous shock to the deposit supply curve in markets with different levels of bank market power. If deposit demand curve is steeper in markets with high bank market power, with a negative shock to the deposit supply curve, we expect to observe less quantity contractions in markets with high bank market power, as steeper demand curve attenuates the equilibrium effects on quantity of supply curve contractions. Figure 3 illustrates the identification strategy we intend to implement. In Figure 3, the solid line is the deposit demand curve in the high bank market power area; the dashed line is the deposit demand curve in the low bank market power area; the dotted line is the deposit supply curve under normal conditions; and the dash-dotted line is the deposit supply curve

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[8] For small business lending results, we also conduct logarithm transformation without plus 1, and our results on small business lending does not hinge on this transformation.

with a negative shock. With a negative shock to the deposit supply curve, we expect less quantity contractions in the high bank market power area ($\Delta Q_H < \Delta Q_L$).

[Insert Figure 3 around here]

Motivated by the relationship between stock market performance and aggregate deposit growth rate in Figure 1, and studies by Lin (2020) and Farrell and Eckerd (2021), we use stock market performance, specifically the Sharpe ratio of the S&P 500 index, as a negative shock to the deposit supply curve to identify the relationship between bank market power and the slope of deposit demand. Using geographic deposit data and individual account data respectively, Lin (2020) and Farrell and Eckerd (2021) argue that investors exhibit "return chasing" behavior and allocate away from deposit assets when recent past stock market performance is good. Their empirical evidence suggests that stock market performance is a valid shock to the deposit supply curve.

However, as we cannot conduct randomized experiments, we need to address two other sources of endogeneity to establish the causal link, namely heterogeneous supply curve shiftings and heterogeneous demand curve shiftings, both of which can be caused by omitted variables. These two channels lead to observational equivalence ($\Delta Q_H < \Delta Q_L$) for reasons other than bank market power making deposit demand curve steeper, and we discuss below in detail how we address these two possible channels.

3.1 Heterogeneous Supply Shiftings

The first challenge is that the supply curve shiftings are not randomized. If high bank market power areas simply experience less supply curve contractions after good stock market performance, then we will naturally observe less quantity contractions in high bank market power areas, but this has nothing to do with market power steepening demand curve and attenuating the effects of supply curve contractions. This scenario is illustrated in Figure 4. In Figure 4, the solid line is the deposit demand curve in both the high and low bank market power areas, so market power is assumed to be independent of the slope of the demand curve; the dashed line is the deposit supply curve under normal conditions; the dotted line is the deposit supply curve in the high bank market power area after good stock market performance; and the dash-dotted line is the deposit supply curve in the low bank market power area after good stock market performance.

[Insert Figure 4 around here]

As local bank market power is not randomized, it is possible that markets with different levels of bank market power experience heterogeneous supply shiftings. For example, Lin

(2020) argues that stock market participation rate amplifies the contraction effects on the deposit market of good stock market performance. If local bank market power is negatively correlated with stock market participation rate, then high bank market power areas with low stock market participation rate would experience less supply contractions after good stock market performance, which leads to less deposit quantity contractions. To account for the possibility of heterogeneous supply shiftings in driving the results, we need to account for the correlations between bank market power and factors that can shift deposit supply curve heterogeneously. As depositors are defined as the supply side, local household demographics are more likely to be supply shifters, and we need to control for heterogeneous demographics as closely as possible. We discuss below in detail how we address this channel.

First, we conduct the following geographic level regression with geographic-parent×year fixed effects:

$$\Delta Dep_{mnt} = \alpha_m + \mu_{nt} + \delta^q HHI_{mt-1} \times SR_{t-1} + \beta HHI_{mt-1} + controls + \varepsilon_{mnt}, \tag{4}$$

where m indexes geographic level (city or county); n indexes geographic-parent level (county or state, respectively); and t indexes year. ΔDep_{mnt} is the log deposit growth rate in geographic area m from year $t-1$ to year t; α_m stands for geographic fixed effects; μ_{nt} stands for geographic-parent×year fixed effects; HHI_{mt-1} is the Herfindahl index in geographic area m at the end of year $t-1$; and SR_{t-1} is the lagged Sharpe ratio of the S&P 500 index through year $t-1$. We cluster standard errors at the respective geographic-parent level.

If bank market power makes deposit demand curve steeper, then the regression coefficient δ^q from Equation 4 should be positive ($\delta^q > 0$), as steeper demand curve attenuates the effects on quantity of supply curve contractions. The identifying assumptions of Equation 4 are: (1) there is no heterogeneous demand curve shiftings, which we will address in the next section; and (2) bank market power is not correlated with variables that can shift deposit supply curve heterogeneously. We use geographic-parent×year fixed effects to account for both time-invariant and time-varying demographics that can potentially shift deposit supply curve heterogeneously at county or state level. By comparing deposit growth rate in different cities (counties) within the same county (state), our results cannot be explained by county (state) level difference in demographics.

We present the regression results of Equation 4 in Table 2. Column (1) and (2) are city level results with branch and bank level HHI, while Column (3) and (4) are county level results with branch and bank level HHI. As suggested by the positive coefficient on the interaction term between lagged Sharpe ratio and bank market power across different specifications, it confirms that more concentrated cities (counties) experience less deposit contractions when lagged Sharpe ratio is high, compared with less concentrated cities (counties) within the same county (state). The value of the coefficient ranges from 0.008 with the most restrictive city and county×year fixed effects, to 0.018 with county and state×year fixed effects. In terms of magnitude, these coefficients suggest that when lagged Sharpe ratio is one standard deviation (0.378) above the mean, cities (counties) with one standard deviation above the mean HHI level experience 0.1% (0.16%) less deposit growth contractions, compared with cities (counties) with mean HHI level located within the same county (state).

[Insert Table 2 around here]

Even though our results in Table 2 cannot be explained by geographic-parent level difference in demographics, it is possible that within county (state) demographics variation can still shift supply curve heterogeneously. However, we want to point out that if bank market power is positively (negatively) correlated with geographic demographics that can amplify (attenuate) supply contractions, for example when bank market power is positively correlated with stock market participation rate, then high bank market power areas are expected to experience more supply contractions and the omitted variable tends to work against us and downward bias our estimate of δ^q.

Finally, notice that if bank market power makes deposit demand curve steeper, high bank market power areas are expected to experience more price increase when supply curve contracts, as steeper demand curve amplifies the effects on price of supply contractions. On the other hand, if our results in Table 2 are driven by heterogeneous supply shiftings, then less quantity contractions should be associated with less price increase when demand is identical but supply contracts heterogeneously. Therefore, these two channels generate different price predictions. So to further alleviate the concern that our results in Table 2 are driven by within county (state) variation in demographics, we conduct the following price regression with geographic-parnet×month fixed effects corresponding to our quantity specification Equation 4:

$$\Delta APY_{ijmnklt} = \alpha_{iml} + \mu_{nt} + \delta^p HHI_{mt-12} \times SR_{t-12} + \beta HHI_{mt-12} + controls + \varepsilon_{ijmnklt}, \tag{5}$$

where i indexes entity (branch or bank); j indexes entity-parent (bank or BHC, respectively); m indexes geographic level (city or county); n indexes geographic parent (county or state, respectively); k indexes branch; l indexes deposit product; and t indexes month. $\Delta APY_{ijmnklt}$ is the change in the annul percentage yield of product l provided by branch k from month $t-12$ to t; α_{iml} stands for entity×geographic×product fixed effects; μ_{nt} stands for geographic-parent×month fixed effects; HHI_{mt-12} is the Herfinahl index in geographic area m at the end of previous year; and SR_{t-12} is the Sharpe ratio of the S&P index at the end of month $t-12$. We two way cluster the standard errors at entity-parent and geographic-parent level.

A discussion is needed about specification Equation 5. We use geographic level specification Equation 4 to address the heterogeneous supply shiftings channel. Corresponding to Equation 4, ideally, we want to conduct price regressions at geographic level too. However, although we have deposit rate data at the branch level, we do not observe the composition of branch level deposits, so there is no proper way to aggregate deposit rate data to geographic level. Therefore, we leave the deposit rate data at branch×product×month level ($k \times l \times t$), and use i, j, m, n, t to construct fixed effects corresponding to quantity regression of Equation 4.

If bank market power makes deposit demand curve steeper, more concentrated areas will experience more price increase when supply contracts. This implies that the regression coefficient δ^p from Equation 5 would be positive ($\delta^p > 0$). However, if our quantity results in Table 2 are driven by heterogeneous supply shiftings, then the regression coefficient δ^p from Equation 5 would be negative ($\delta^p < 0$), as markets experience less supply contractions are expected to experience less price increase.

We present the regression results of Equation 5 in Table 3. Column (1) and (2) are city level results with branch and bank level HHI, while Column (3) and (4) are county level results with branch and bank level HHI. As suggested by the positive coefficient on the interaction term between lagged Sharpe ratio and bank market power across different specifications, it confirms that branches located in more concentrated cities (counties) experience more deposit price increase when lagged Sharpe ratio is high, compared with branches located in less concentrated cities (counties) within the same county (state). As all regressions are based on branch level data with different entity and geographic level fixed effects, the value of coefficients with county×month fixed effects is stable around 0.018. In terms of magnitude, these coefficients suggest that when lagged Sharpe ratio is one standard deviation (0.378) above the mean, branches located in cities (counties) with one standard deviation above the mean HHI level experience 0.23 bps (0.17 bps) more increase in deposit rate, compared with branches located in cities (counties) with mean HHI level within the same county (state).

[Insert Table 3 around here]

Taken together, the results in Table 2 and Table 3 show that more concentrated cities and counties experience less quantity contractions but more price increase at the same time after good stock market performance. These combined results suggest that the quantity results in Table 2 are unlikely to be driven by heterogeneous supply shiftings, as heterogeneous supply shiftings would predict less quantity contractions to be associated with less price increase.

3.2 Heterogeneous Demand Shiftings

The second challenge is that our results may be driven by heterogeneous demand shiftings. If stock market performance is associated with deposit demand contractions and bank market power is correlated with factors that can shift demand curve heterogeneously, then we may observe less quantity contractions in high bank market power areas due to less deposit demand contractions. This scenario is illustrated in Figure 5. In Figure 5, the solid line is the deposit demand curve in both the high and low bank market power areas under normal conditions; the dashed line is the deposit supply curve in both the high and low bank market power areas; the dotted line is the deposit demand curve in the high bank market power area after good stock market performance; and the dash-dotted line is the deposit demand curve in the low bank market power area after good stock market performance.

[Insert Figure 5 around here]

The scenario in Figure 5 is especially likely to be true when stock market performance is associated with credit demand contractions. As banks simultaneously take deposit and extend loans, they are likely to exert market power in both the deposit and lending market. If stock market performance is associated with credit demand contractions and bank lending market power makes credit supply curve steeper, then high bank market power areas are likely to experience less credit quantity contractions, as steeper credit supply curve attenuates the effects on loan quantity of credit demand contractions. As loans are mainly funded by deposit, less contractions in credit quantity would translate into less contractions in deposit demand, which eventually leads to less deposit quantity contractions in high bank market power areas. To address this possible channel, it is important to control for different lending opportunities across different areas. We discuss below in detail how we address this channel.

First, we conduct the following entity level regression with entity-parent×geographic-parent× year fixed effects:

$$\Delta \log Dep_{ijmnt} = \alpha_{im} + \mu_{jnt} + \delta^q HHI_{mt-1} \times SR_{t-1} + \beta HHI_{mt-1} + controls + \varepsilon_{ijmnt}, \quad (6)$$

where i indexes entity (branch or bank); j indexes entity parent (bank or BHC, respectively); m indexes geographic area (city or county); n indexes geographic parent (county of state, respectively); and t indexes year. $\Delta \log Dep_{ijmnt}$ is the log deposit growth rate of entity i in geographic area m from year $t-1$ to year t; α_{im} stands for entity×geographic fixed effects; μ_{jnt} stands for entity-parent×geographic-parent×year fixed effects; HHI_{mt-1} is the Herfindahl index in geographic area m at the end of year $t-1$; and SR_{t-1} is the S&P

500 Sharpe ratio in year $t-1$. We two-way cluster standard errors at entity-parent and geographic-parent level.

The identifying assumption behind our within entity-parent×geographic-parent estimation is that banks (BHCs) can efficiently use internal capital market to equalize lending opportunities across different cities (counties) within the same county (state), so within the same bank (BHC), there is no heterogeneous demand shiftings across cities (counties) within the same county (state). This identifying assumption can be supported by empirical studies showing the effects of banks' internal capital markets (Ben-David, Palvia, & Spatt, 2017; Cortés & Strahan, 2017; Gilje et al., 2016), and this identifying assumption is most similar to the one in Drechsler et al. (2017), but similar identification strategies are widely used in the banking literature (e.g., Jiménez et al., 2012, 2014; Peydró et al., 2021, to name a few). However, different from Drechsler et al. (2017), who use a bank×year fixed effects specification, we exploit a more restrictive specification with entity-parent×geographic-parent×year fixed effects. A bank×year fixed effects specification assumes that banks can efficiently allocate capital across all areas, while a entity-parent×geographic-parent×year fixed effects specification relaxes the assumption to that banks (BHCs) can efficiently allocate capital across areas within the same county (state). This specification further alleviates the concern that internal capital market can be segmented for multiple reasons. For example, (1) local regulations can prohibit the integration of operations and capital reallocation across different areas; (2) decentralized operations can also segment local entities; or (3) soft private information in the local lending market can segment the lending market and henceforth the internal capital market. Finally, notice that the entity-parent×geographic-parent×year fixed effects also absorb the geographic-parent×year fixed effects used in Equation 6 to address heterogeneous supply shiftings.

We present the regression results of Equation 6 in Table 4. Column (1) and (2) are branch-city and bank-city level result, while Column (3) and (4) are branch-county and bank-county level results. As suggested by the positive coefficient on the interaction term between lagged Sharpe ratio and bank market power across different specifications, it confirms that branches (banks) located in more concentrated cities (counties) experience less deposit contractions when lagged Sharpe ratio is high, compared with branches (banks) with the same parent bank (BHC) located in less concentrated cities (counties) within the same county (state). The value of the coefficient ranges from 0.007 with the most restrictive branch and bank×county×year fixed effects, to 0.016 with bank and BHC×state×year fixed effects. In terms of magnitude, these coefficients suggest that when lagged Sharpe ratio is one standard deviation (0.378) above the mean, branches (banks) located in cities (counties) with one standard deviation above the mean HHI level experience 0.1% (0.14%) less deposit growth contractions, compared with branches (banks) located in cities (counties) with mean HHI level within the same county (state).

[Insert Table 4 around here]

We also conduct the following price regression with entity-parent×geographic-parent× month fixed effects:

$$\Delta APY_{ijmnklt} = \alpha_{iml} + \mu_{jnt} + \delta^p HHI_{mt-12} \times SR_{t-12} + \beta HHI_{mt-12} + controls + \varepsilon_{ijmnklt}, \tag{7}$$

where i indexes entity (branch or bank); j indexes entity-parent (bank or BHC, respectively); m indexes geographic level (city or county); n indexes geographic parent (county or state, respectively); k indexes branch; l indexes deposit product; and t indexes month. $\Delta APY_{ijmnklt}$ is the change in the annul percentage yield of product l provided by branch k from month $t-12$ to t; α_{iml} stands for entity×geographic×product fixed effects; μ_{jnt} stands for entity-parent×geographic-parent×month fixed effects; HHI_{mt-12} is the Herfinahl index in geographic area m at the end of previous year; and SR_{t-12} is the Sharpe ratio of the S&P index at the end of month $t-12$. We two way cluster the standard errors at entity-parent and geographic-parent level.

We do not find any evidence showing that branches (banks) with the same parent bank (BHC) located in different cities (counties) within the same county (state) price deposit products differently. The detailed results are presented in Table A.3. Our interpretation of the results is that there is limited variation in deposit rate within the same bank (or even BHC). The R-squared coefficients from price regressions of both Equation 5 (Table 3) and Equation 7 (Table A.3) are above 70% or even above 80%, these high R-squared coefficients suggest limited within county and within bank×county price variation. Recent studies by Granja and Paixao (2019) and Begenau and Stafford (2022) also argue that uniform deposit pricing is the common practice among US banks, which also suggests limited within bank price variation.

A final comment worth noting is that the regression coefficient δ^p in Equation 7 does not help us to differentiate the demand slope theory and heterogeneous demand shiftings theory, as both theories predict $\delta^p > 0$ in Equation 7. The demand slope theory predicts more price increase ($\delta^p > 0$) as steeper demand curve amplifies the effects on price of supply contractions, while the heterogeneous demand shiftings theory predict less price decrease ($\delta^p > 0$) to be associated with less demand contractions.

Finally, we conduct the following quantity and price regressions to further alleviate the concern of heterogeneous demand shiftings channel:

$$\Delta Dep_{mnt} = \alpha_m + \beta^q SR_{t-1} + \delta^q HHI_{mt-1} \times SR_{t-1} + \beta HHI_{mt-1} + controls + \varepsilon_{mnt}, \tag{8}$$

where m indexes geographic level (city or county); n indexes geographic-parent level (county or state, respectively); and t indexes year. ΔDep_{mnt} is the log deposit growth rate in geographic area m from year $t-1$ to year t; α_m stands for geographic fixed effects; HHI_{mt-1} is the Herfindahl index in geographic area m at the end of year $t-1$; and SR_{t-1} is the lagged Sharpe ratio of the S&P 500 index through year $t-1$. We cluster standard errors at the respective geographic-parent level. And

$$\begin{aligned} \Delta APY_{ijmnklt} = &\alpha_{iml} + \beta^p SR_{t-12} + \delta^p HHI_{mt-12} \times SR_{t-12} \\ &+ \beta HHI_{mt-12} + controls + \varepsilon_{ijmnklt}, \end{aligned} \tag{9}$$

where i indexes entity (branch or bank); j indexes entity-parent (bank or BHC, respectively); m indexes geographic level (city or county); n indexes geographic parent (county or state, respectively); k indexes branch; l indexes deposit product; and t indexes month. $\Delta APY_{ijmnklt}$ is the change in the annul percentage yield of product l provided by branch k from month $t-12$ to t; α_{iml} stands for entity×geographic×product fixed effects; HHI_{mt-12} is the Herfinahl index in geographic area m at the end of previous year; and SR_{t-12} is the Sharpe ratio of the S&P index at the end of month $t-12$. We two way cluster the standard errors at entity-parent and geographic-parent level.

If stock market performance is correlated with deposit demand contractions, we expect both β^q (Equation 8) and β^p (Equation 9) to be negative ($\beta^q < 0$ and $\beta^p < 0$). On the other hand, if stock market performance is correlated with deposit supply contractions, we expect β^q to be negative but β^p to be positive ($\beta^q < 0$ and $\beta^p > 0$). We use these two equations to further verify that stock market performance is unlikely to be associated with deposit demand contractions, which further alleviates the concern that our results in Table 4 are driven by heterogeneous demand shiftings.

We present the regression results of Equation 8 in Table 5. Column (1) and (2) are branch-city and bank-city level results, while Column (3) and (4) are branch-county and bank-county level results. As suggested by the negative coefficient on lagged Sharpe ratio, it confirms that stock market performance is associated with deposit quantity contractions. The value of coefficient ranges from -0.13 to -0.15. In terms of magnitude, these coefficients suggest that when lagged Sharpe ratio is one standard deviation (0.378) above the mean, deposit growth rate contracts by 4.91% (5.67%) at the city (county) level. Corresponding to the coefficients on lagged Sharpe ratio, the value of coefficient on the interaction term between lagged Sharpe ratio and bank market power is 0.016 and 0.027, respectively. These coefficients suggest that cities (counties) with one standard deviation above the mean HHI level experience 0.21% (0.25%) less deposit growth contractions, compared with cities (counties) with mean HHI level within the same county (state).

[Insert Table 5 around here]

We present the regression results of Equation 9 in Table 6. Column (1) and (2) are branch-city and bank-city level results, while Column (3) and (4) are branch-county and bank-county level results. As suggested by the positive coefficient on lagged Sharpe ratio, it confirms that stock market performance is associated with deposit rate increase. The value of coefficient is stable around 0.31. In terms of magnitude, these coefficients suggest that when lagged Sharpe ratio is one standard deviation (0.378) above the mean, branch level deposit rate increases by 12 bps approximately. The value of coefficient on the interaction term between lagged Sharpe ratio and bank market power ranges from 0.054 to 0.09, suggesting that branches located in cities (counties) with one standard deviation above the mean HHI level experience 0.71 bps (0.80 bps) more deposit rate increase.

[Insert Table 6 around here]

Combining the results in Table 5 and Table 6, we find that lagged Sharpe ratio is associated with deposit quantity contractions but deposit rate increase, so stock market performance is unlikely to be associated with demand contractions, as demand contractions move quantity and price in the same direction. Therefore, we conclude that our results in Table 4 are unlikely to be driven by heterogeneous demand shiftings.

3.3 Summary of Main Findings

We present a summary of our main findings in Table 7. Using both geographic-parent×year (Equation 4) and entity-parent×geographic-parent×year (Equation 6) fixed effects specification to account for heterogeneous supply and demand shiftings, we find that more concentrated areas experience less deposit contractions after good stock market performance. The price regression results of Equation 5 show that more concentrated areas experience more price increase after good stock market performance, which contradicts the heterogeneous supply shiftings theory, as heterogeneous supply shiftings theory predicts less quantity contractions to be associated with less price increase. The regression results of Equation 7 do not show significant evidence. And the regression results of Equation 8 and Equation 9 show that stock market performance is associated with quantity contractions but price increase, so it is unlikely to be associated with deposit demand contractions, which contradicts the heterogeneous demand shiftings theory. Overall, our results suggest that bank market power makes deposit demand curve steeper.

[Insert Table 7 around here]

As Lin (2020) documents excess return as the deposit supply shock, for robustness checks, we also conduct regression analysis of Equation 6 (our most restrictive specification) using lagged excess return as the deposit supply shock instead of lagged Sharpe ratio, and the results are qualitatively stronger when we use lagged excess return as the supply shock. Detailed results can be found in Table A.4.

4 Other Results

In this section, we discuss the relationship between our results and the most related literature. As there is limited variation in the deposit rate data, in this section we will focus on deposit growth results only.

4.1 The Deposit Channel of Monetary Policy

Our study is most closely related to Drechsler et al. (2017), as we exploit similar identification strategy to investigate the role of bank market power in the deposit market. However, the mechanism in our study is different from the mechanism in Drechsler et al. (2017). We study how bank market power interacts with deposit supply shiftings, while Drechsler et al. (2017) study how bank market power interacts with deposit supply elasticity (demand elasticity in their framework). We discuss the difference between our mechanism and Drechsler et al. (2017) mechanism below. Notice that in our framework, banks are the demand side and depositors are the supply side, while in the Drechsler et al. (2017) framework, banks are the supply side and depositors are the demand side. For easy of comparison, we define depositors as the supply side in our discussion below.

In the Drechsler et al. (2017) framework, there are three classes of assets for investors, cash, bond, and deposit. Cash is the most liquid but most expensive to hold, as cash does not generate any returns; bond is the most illiquid asset but generates the highest returns; and deposit has both moderate liquidity and moderate returns. Bond bears returns equal to interest rate and also stands for the opportunity cost of holding cash and deposit. So when interest rate increases, the opportunity cost of holding cash and deposit increases, which causes contractions in deposit supply. However, as cash generates zero returns, cash becomes prohibitively expensive to hold, which makes deposit supply inelastic. Banks take deposit and extend loans at the rate of interest rate, so banks price deposit at the rate where their supply elasticity equals to 1 to maximize profit. In a monopsony market, the monopsony bank's supply is the same as aggregate supply, so inelastic aggregate supply curve gives market power to the monopsony bank and the monopsony bank increases the spread between interest rate and deposit rate to the point where the deposit supply elasticity equals to 1 again. However, in a competitive market, even though aggregate deposit supply for the whole industry becomes inelastic, individual banks face price competition from other banks providing similar deposit products, so the price competition and customer stealing effects make individual banks' supply curve more elastic than the aggregate supply, which limits banks' ability to exert market power to increase the spread between interest rate and deposit rate. As a result, when interest rate increases, banks in competitive markets increase deposit rate more than the monopsony bank, and markets with high bank market power experience more deposit outflows. To summarize, there are two necessary conditions in the Drechsler et al. (2017) study: (1) increasing interest rate makes deposit supply curve inelastic; and (2) within bank price competition makes individual banks' supply curve more elastic and attenuates banks' ability to exploit market power. And as a result, in Drechsler et al. (2017), bank market power amplifies the contraction effects on the deposit market of interest rate increase.

On the other hand, in our framework, we assume that (1) for an individual bank, the marginal willingness to pay for deposit is decreasing, so the demand curve is downward sloping; and (2) bank competition drives up the price and flattens the demand curve, and as a result, in sharp contrast to Drechsler et al. (2017), bank market power attenuates, instead of amplifies, the effects on the deposit market of supply curve contractions. To conclude the difference between our study and Drechsler et al. (2017), we study how bank market power interacts with deposit supply shiftings and identify the relationship between bank market power and the slope of deposit demand, while Drechsler et al. (2017) study how bank market power interacts with deposit supply elasticity and identify how banks price deposit products when deposit supply becomes inelastic.

To visualize our results against the Drechsler et al. (2017) results, we conduct the following analysis. First, in each year t, we sort all cities into deciles based on branch-city level Herfindahl index. Then for each decile g, we conduct the following quantity regression:

$$\Delta Dep_{mgt} = \alpha_m + \beta^q_{LSR} SR_{t-1} + \beta^q_{FF} FF_t + \varepsilon_{mgt}, \tag{10}$$

where m indexes city; g indexes HHI decile; and t indexes year. ΔDep_{mgt} is the log deposit growth rate in city m from year $t-1$ to year t; α_m stands for city fixed effects; SR_{t-1} is the Sharpe ratio of S&P 500 index in year $t-1$; and FF_t is the change in Fed Funds rate from year $t-1$ to year t. We cluster standard errors at county level.

Second, we repeat the process for deposit rate data. We sort branch level price data into deciles based on branch-city level Herfindahl index. Then for each decile g, we conduct the following price regression:

$$\Delta APY_{klgt} = \alpha_{kl} + \beta^{p}_{LSR} SR_{t-12} + \beta^{p}_{FF} FF_t + \varepsilon_{klgt}, \tag{11}$$

where k indexes branch; l indexes deposit product; g indexes HHI decile; and t indexes month. ΔAPY_{klgt} is the change in annual percentage yield of product l provided by branch k from month $t-12$ to month t; α_{kl} stands for branch×product fixed effects; SR_{t-12} is the Sharpe ratio of S&P 500 index at the end of month $t-12$; and FF_t is the change in Fed Funds rate from month $t-12$ to month t. We two-way cluster standard errors at bank and county level.

Figure 6 visualizes our main findings against Drechsler et al. (2017). In Panel A, we plot (β^{q}_{LSR}, β^{q}_{FF}) from Equation 10 against HHI decile g; and in Panel B, we plot (β^{p}_{LSR}, β^{p}_{FF}) from Equation 11 against HHI decile g. The solid line connects the coefficients of β^{q}_{LSR}; the dashed line connects the coefficients of β^{q}_{FF}; the solid-dotted line connects the coefficients of β^{p}_{LSR}; and the dash-dotted line connects the coefficients of β^{p}_{FF}.

[Insert Figure 6 around here]

As we can see from Panel A, in the least concentrated cities, lagged Sharpe ratio is strongly associated with deposit growth contractions. However, as market power grows, the contraction effect becomes weaker. In contrast, the contraction effect of change in Fed Funds rate is strongest in the most concentrated cities. Panel B presents the price effects. We can see from Panel B that lagged Sharpe ratio is positively associated with deposit rate increase, and the most concentrated cities experience the most price increase. In contrast, the least concentrated cities experience the most increase in price when Fed Funds rate increases.

To formalize our results together with the deposit channel of monetary policy, we conduct the following quantity regression:

$$\begin{aligned}\Delta \log Dep_{ijmnt} =& \alpha_{im} + \mu_{jnt} + \delta^{q}_{LSR} HHI_{mt-1} \times SR_{t-1} + \delta^{q}_{FF} HHI_{mt-1} \times FF_t \\ &+ \beta HHI_{mt-1} + controls + \varepsilon_{ijmnt},\end{aligned} \tag{12}$$

where i indexes entity (branch or bank); j indexes entity parent (bank or BHC, respectively); m indexes geographic area (city or county); n indexes geographic parent (county of state, respectively); and t indexes year. $\Delta \log Dep_{ijmnt}$ is the log deposit growth rate of entity i in geographic area m from year $t-1$ to year t; α_{im} stands for entity×geographic fixed effects; μ_{jnt} stands for entity-parent×geographic-parent×year fixed effects; HHI_{mt-1} is the Herfindahl index in geographic area m at the end of year $t-1$; SR_{t-1} is the S&P 500 Sharpe ratio in year $t-1$; and FF_t is the change of Fed Funds rate from year $t-1$ to t as in Drechsler et al. (2017). We two-way cluster standard errors at entity-parent and geographic-parent level.

We present the regression results of Equation 12 in Table 8.[9] Column (1) and (2) are branch-city and bank-city level results, while Column (3) and (4) are branch-county and bank-county level results. As suggested by the positive coefficient on the interaction term between lagged Sharpe ratio and bank market power across different specifications, it confirms that branches (banks) located in more concentrated cities (counties) experience less deposit contractions when lagged Sharpe ratio is high, compared with branches (banks) with the same parent bank (BHC) located in less concentrated cities (counties) within the same county (state). In contrast, as suggested by the negative coefficient on the interaction term between change in Fed Funds rate and bank market power in Column (3) and (4), branches (banks) located in more concentrated counties experience more deposit contractions when interest rate increases, compared with branches (banks) with the same parent bank (BHC) located in less concentrated counties within the same state. These results highlight the different roles of market power in interacting with supply shiftings and supply elasticity.

[Insert Table 8 around here]

4.2 Does the Effect Aggregate?

A recent study by Begenau and Stafford (2022) argues that the deposit channel does not aggregate. In this section we conduct aggregate analysis.

[Insert Figure 7 around here]

[Insert Table 9 around here]

4.3 Real Effects

In this section we discuss the effects on lending of stock market spillover. So far we have discussed how bank market power can attenuate the spillover effects on the deposit market of the stock market. If good stock market performance causes contractions in deposit supply and banks cannot perfectly substitute deposit with other funding sources, then good stock market performance can lead to contractions in lending.

To test the real effects on lending, we conduct the following lending regression:

$$\log(1 + Loan_{mnt}) = \alpha_m + \mu_{nt} + \delta HHI_{mt-1} \times SR_{t-1} + \beta HHI_{mt-1} + controls + \varepsilon_{mnt}, \quad (13)$$

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[9] A replication of Table 3 in Drechsler et al. (2017) can be found in Table A.2.

where m indexes county; n indexes state; and t indexes year. $\log(1 + Loan_{mnt})$ is either the log amount of small business lending or the log number of small business lending in county m in year t. α_m stands for county fixed effects; μ_{nt} stands for state×year fixed effects; HHI_{mt-1} is the Herfindahl index in county m at the end of year $t-1$; and SR_{t-1} is the S&P 500 Sharpe ratio in year $t-1$. We cluster standard errors at the state level.

We present the regression results of Equation 13 using branch-county HHI in Table 10 (results with bank-county HHI are presented in Table A.5 in the appendix). Column (1) and (2) are loan amount results without and with state×year fixed effects, while Column (3) and (4) are loan number results without and with state×year fixed effects. As suggested by the negative coefficient on lagged Sharpe ratio in Column (1) and (3), it confirms that good stock market performance is negatively associated with small business lending, in terms of both loan amount and number of loans. In contrast, as suggested by the positive coefficient on the interaction term between lagged Sharpe ratio and bank market power in Column (4), it confirms that more concentrated counties experience less contractions in small business lending when stock market performance is good, in terms of loan numbers. In terms of magnitude, a one standard deviation increase in lagged Sharpe ratio (0.378) is approximately associated with 7.75% (-0.205×0.378) contractions in small business lending amount and 20.22% (-0.535×0.378) contractions in number of small business lending loans. The larger contractions in number of loans than amount of loans also suggest that marginal borrowers are more likely to be affected. On the other hand, the value of the coefficient on the interaction term between lagged Sharpe ratio and bank market power is 0.121 in the loan number regression, which suggests that counties with 1 standard deviation (0.255) above the mean HHI level experience 1.17% less contractions in loan numbers. We don't find significant evidence showing that more concentrated counties experience more loan amount contractions compared with less concentrated counties within the same state, this again suggests that the spillover effects are concentrated on marginal small borrowers.

The small business lending results suggest that good stock market performance has negative spillover effects on small business lending and the effects are more concentrated on marginal borrowers. On top of that, bank market power attenuates the negative spillover effects, in terms of both loan amount and number of loans.

[Insert Table 10 around here]

5 Conclusion

We find that at the aggregate level, stock market performance is strongly negatively correlated with deposit growth rate. Recent literature (Farrell & Eckerd, 2021; Lin, 2020) suggests that the negative correlation is largely due to asset reallocation behavior of households from the deposit market to the stock market. Using stock market performance as a shock to deposit supply, we trace out banks' deposit demand curve and pin down the relationship between bank market power and deposit demand. We find that when stock market performance is good, branches located in more concentrated areas experience less deposit contractions, compared with branches located in less concentrated areas with the same parent bank. Our results suggest that bank market power makes deposit demand curve steeper, which attenuates the negative spillover effects of the stock market. Our findings complement the structural quantitative studies on bank competition in the deposit market (e.g., Egan et al., 2017; Wang et al., 2022).

Deposit supply contractions also lead to contractions in small business lending, and we find that when stock market performance is good, more concentrated areas also experience less contractions in lending. These results suggest that bank market power also attenuates the negative spillover effects on lending of the stock market. Overall, our results show that bank market power insulates and stabilizes both local deposit and lending market from stock market fluctuations.

References

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

Andonov, A., & Rauh, J. D. (2020). The return expectations of institutional investors. *Stanford University Graduate School of Business Research Paper*.

Becker, B. (2007). Geographical segmentation of us capital markets. *Journal of Financial Economics*, *85*(1), 151–178.

Begenau, J., & Stafford, E. (2022). Uniform rate setting and the deposit channel. *Available at SSRN 4136858*.

Ben-David, I., Palvia, A., & Spatt, C. (2017). Banks' internal capital markets and deposit rates. *Journal of Financial and Quantitative Analysis*, *52*(5), 1797–1826.

Berger, A. N., & Hannan, T. H. (1989). The price-concentration relationship in banking. *The Review of Economics and Statistics*, 291–299.

Bernanke, B. S., & Blinder, A. S. (1988). Credit, money, and aggregate demand. *The American Economic Review*, *78*(2), 435.

Bernanke, B. S., Blinder, A. S., et al. (1992). The federal funds rate and the channels of monetary transmission. *American Economic Review*, *82*(4), 901–921.

Chen, Q., Goldstein, I., Huang, Z., & Vashishtha, R. (2022). Bank transparency and deposit flows. *Journal of Financial Economics*, *146*(2), 475–501.

Chen, Q., Vashishtha, R., & Wang, S. (n.d.). The decision relevance of loan fair values for depositors.

Chen, Y.-C., Hung, M., & Wang, L. L. (2022). Do depositors respond to banks' social performance? *The Accounting Review*.

Corbae, D., & D'Erasmo, P. (2021). Capital buffers in a quantitative model of banking industry dynamics. *Econometrica*, *89*(6), 2975–3023.

Corbae, D., & D'Erasmo, P. (2020). Rising bank concentration. *Journal of Economic Dynamics and Control*, *115*, 103877.

Cornett, M. M., McNutt, J. J., Strahan, P. E., & Tehranian, H. (2011). Liquidity risk management and credit supply in the financial crisis. *Journal of Financial Economics*, *101*(2), 297–312.

Cortés, K. R., & Strahan, P. E. (2017). Tracing out capital flows: How financially integrated banks respond to natural disasters. *Journal of Financial Economics*, *125*(1), 182–199.

Diamond, D. W., & Dybvig, P. H. (1983). Bank runs, deposit insurance, and liquidity. *Journal of Political Economy*, *91*(3), 401–419.

Dick, A. A. (2008). Demand estimation and consumer welfare in the banking industry.

Journal of Banking & Finance, *32*(8), 1661–1676.

Diebold, F. X., & Sharpe, S. A. (1990). Post-deregulation bank-deposit-rate pricing: The multivariate dynamics. *Journal of Business & Economic Statistics*, *8*(3), 281–291.

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

Drechsler, I., Savov, A., & Schnabl, P. (2021). Banking on deposits: Maturity transformation without interest rate risk. *The Journal of Finance*, *76*(3), 1091–1143.

Drechsler, I., Savov, A., & Schnabl, P. (2022). How monetary policy shaped the housing boom. *Journal of Financial Economics*, *144*(3), 992–1021.

Driscoll, J. C., & Judson, R. (2013). Sticky deposit rates. *Available at SSRN 2241531*.

Duquerroy, A., Matray, A., & Saidi, F. (2020). Sticky deposit rates and allocative effects of monetary policy.

Duquerroy, A., Matray, A., & Saidi, F. (2022). Tracing banks' credit allocation to their funding costs. *Available at SSRN 4113958*.

Egan, M., Hortaçsu, A., & Matvos, G. (2017). Deposit competition and financial fragility: Evidence from the us banking sector. *American Economic Review*, *107*(1), 169–216.

Farrell, D., & Eckerd, G. (2021). The stock market and household financial behavior. *Available at SSRN 3797054*.

Flynn, S., & Wang, J. (2022). Social connections and bank deposit funding. *Available at SSRN*.

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

Gilje, E. P., Loutskina, E., & Strahan, P. E. (2016). Exporting liquidity: Branch banking and financial integration. *The Journal of Finance*, *71*(3), 1159–1184.

Goldstein, I., & Pauzner, A. (2005). Demand–deposit contracts and the probability of bank runs. *The Journal of Finance*, *60*(3), 1293–1327.

Granja, J., & Paixao, N. (2019). Market concentration and uniform pricing: Evidence from bank mergers. *Available at SSRN 3488035*.

Greenwood, R., & Shleifer, A. (2014). Expectations of returns and expected returns. *The Review of Financial Studies*, *27*(3), 714–746.

Hannan, T. H., & Berger, A. N. (1991). The rigidity of prices: Evidence from the banking industry. *The American Economic Review*, *81*(4), 938.

Heider, F., Saidi, F., & Schepens, G. (2019). Life below zero: Bank lending under negative policy rates. *The Review of Financial Studies*, *32*(10), 3728–3761.

Ivashina, V., & Scharfstein, D. (2010). Bank lending during the financial crisis of 2008.

Journal of Financial Economics, *97*(3), 319–338.

Iyer, R., & Puri, M. (2012). Understanding bank runs: The importance of depositor-bank relationships and networks. *American Economic Review*, *102*(4), 1414–45.

Iyer, R., Puri, M., & Ryan, N. (2016). A tale of two runs: Depositor responses to bank solvency risk. *The Journal of Finance*, *71*(6), 2687–2726.

Jiménez, G., Ongena, S., Peydró, J.-L., & Saurina, J. (2012). Credit supply and monetary policy: Identifying the bank balance-sheet channel with loan applications. *American Economic Review*, *102*(5), 2301–26.

Jiménez, G., Ongena, S., Peydró, J.-L., & Saurina, J. (2014). Hazardous times for monetary policy: What do twenty-three million bank loans say about the effects of monetary policy on credit risk-taking? *Econometrica*, *82*(2), 463–505.

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

Kelly, M., & O Grada, C. (2000). Market contagion: Evidence from the panics of 1854 and 1857. *American Economic Review*, *90*(5), 1110–1124.

Levine, R., Lin, C., Tai, M., & Xie, W. (2021). How did depositors respond to covid-19? *The Review of Financial Studies*, *34*(11), 5438–5473.

Li, L., Loutskina, E., & Strahan, P. E. (2019). *Deposit market power, funding stability and long-term credit* (Tech. Rep.). National Bureau of Economic Research.

Li, X., & Ye, Z. (2022). Propagation of the opioid epidemic through the banking network. *Available at SSRN*.

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

Lin, L. (2021). Depositing corporate payout. *Available at SSRN 3959166*.

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

Martinez-Miera, D., & Repullo, R. (2010). Does competition reduce the risk of bank failure? *The Review of Financial Studies*, *23*(10), 3638–3664.

Martinez Peria, M. S., & Schmukler, S. L. (2001). Do depositors punish banks for bad behavior? market discipline, deposit insurance, and banking crises. *The Journal of Finance*, *56*(3), 1029–1051.

Neumark, D., & Sharpe, S. A. (1992). Market structure and the nature of price rigidity: evidence from the market for consumer deposits. *The Quarterly Journal of Economics*, *107*(2), 657–680.

Parra, C. (2016). *Deposit shocks and credit supply: Evidence from us lottery winners.*

University of Texas at Austin.

Peydró, J.-L., Polo, A., & Sette, E. (2021). Monetary policy at work: Security and credit application registers evidence. *Journal of Financial Economics*, *140*(3), 789–814.

Plosser, M. C. (2014). Bank heterogeneity and capital allocation: Evidence from'fracking'shocks. *Available at SSRN 2362499*.

Schumacher, L. (2000). Bank runs and currency run in a system without a safety net: Argentina and thetequila'shock. *Journal of Monetary Economics*, *46*(1), 257–277.

Tanner, N., Zanzalari, D., Manion, M., & Haavind-Berman, E. (2021). Demand elasticity for deposit services at us retail banks in high and low rate environments. *Applied Economics*, *53*(47), 5448–5461.

Wang, Y., Whited, T. M., Wu, Y., & Xiao, K. (2022). Bank market power and monetary policy transmission: Evidence from a structural estimation. *The Journal of Finance*, *77*(4), 2093–2141.

Warther, V. A. (1995). Aggregate mutual fund flows and security returns. *Journal of Financial Economics*, *39*(2-3), 209–235.

White, E. N., & Ó Gráda, C. (2003). The panics of 1854 and 1857: a view from the emigration industrial savings bank. *The Journal of Economic History*, *63*(1), 213–240.

Yankov, V. (2014). In search of a risk-free asset.

Figures and Tables

Figure 1: Aggregate Deposit Growth Rate and Lagged S&P 500 Sharpe Ratio. This figure plots the 12-month rolling core deposit growth rate and lagged Sharpe ratio of the S&P 500 index. Core deposit is defined as the sum of Saving Deposits, Small Time Deposits, and Checkable Deposits following Drechsler et al. (2017).

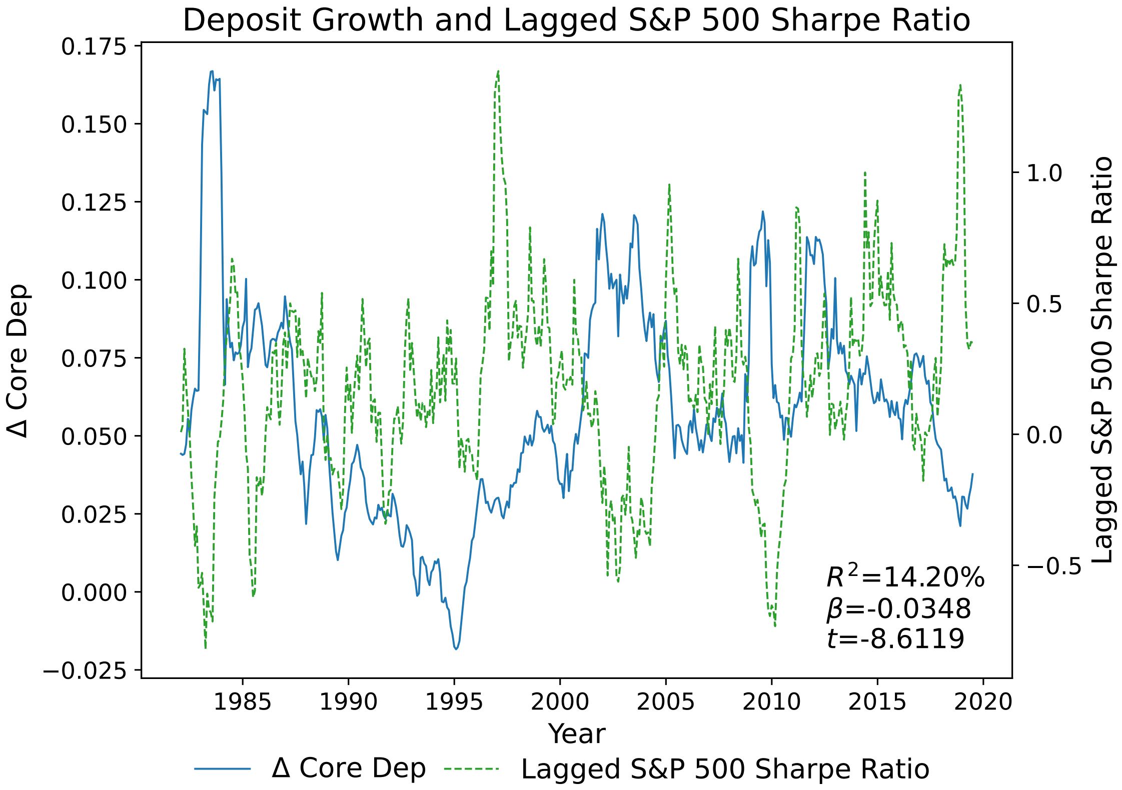

Figure 2: Main Results. This figure visualizes the main findings of this paper. We collect city level deposit quantity and price data and construct city level deposit growth and Herfindahl index. Then for each year t, we sort all cities into 10 deciles. Then for each decile of cities, we conduct the following two regressions:

$$\begin{aligned}\Delta Dep_{mgt} =& \alpha_m + \beta_g^q SR_{t-1} + \varepsilon_{mgt} \\ \Delta APY_{klgt} =& \alpha_{kl} + \beta_g^p SR_{t-12} + \varepsilon_{klgt},\end{aligned}$$

where m indexes city; k indexes branches; l indexes deposit product; g indexes HHI decile; and t indexes year in the quantity equation (the first equation) and month in the price equation (the second equation). ΔDep_{mgt} is the log deposit growth rate in city m from year $t-1$ to year t; SR_{t-1} is the Sharpe ratio of the S&P 500 index in year $t-1$; ΔAPY_{klt} is the change in the annual percentage yield of deposit product l provided by branch k from month $t-12$ to month t; SR_{t-12} is the Sharpe ratio of the S&P 500 index from month $t-24$ to month $t-12$; α_m stands for city fixed effects; and α_{kl} stands for branch×product fixed effects. In this figure we plot the sensitivity of deposit growth to lagged Sharpe ratio (solid line), and the sensitivity of deposit yield change to lagged Sharpe ratio (dashed line) against HHI deciles.

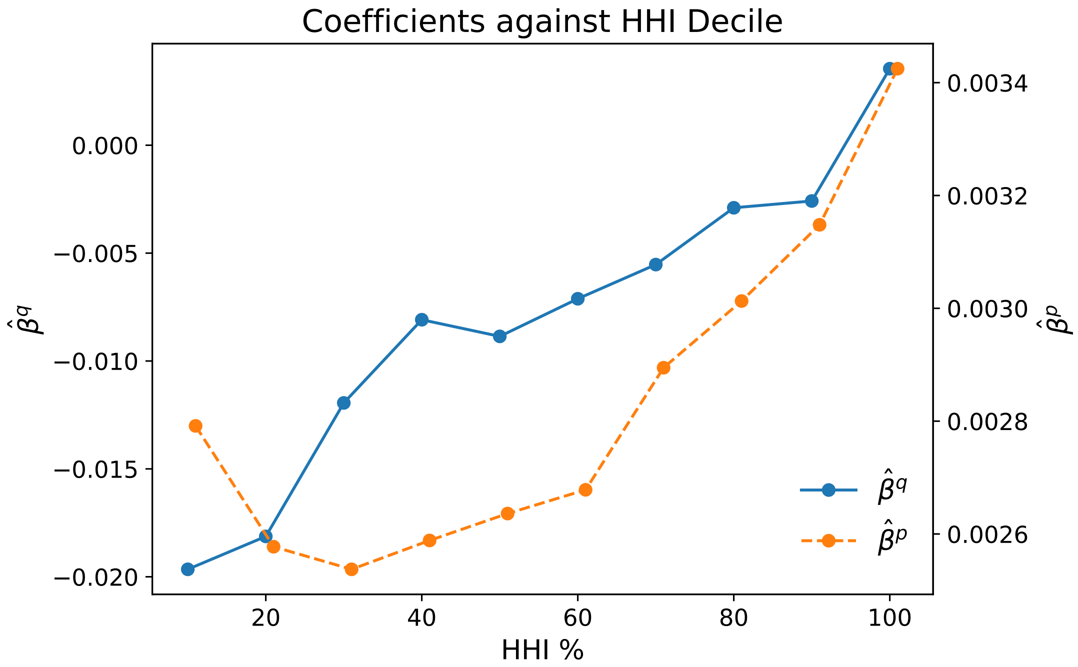

Figure 3: Identification Strategy. This figure plots the identification strategy we intend to implement. The solid line is the deposit demand curve in the high bank market power area; the dashed line is the deposit demand curve in the low bank market power area; the dotted line is the deposit supply curve under normal conditions; and the dash-dotted line is the deposit supply curve with a negative shock.

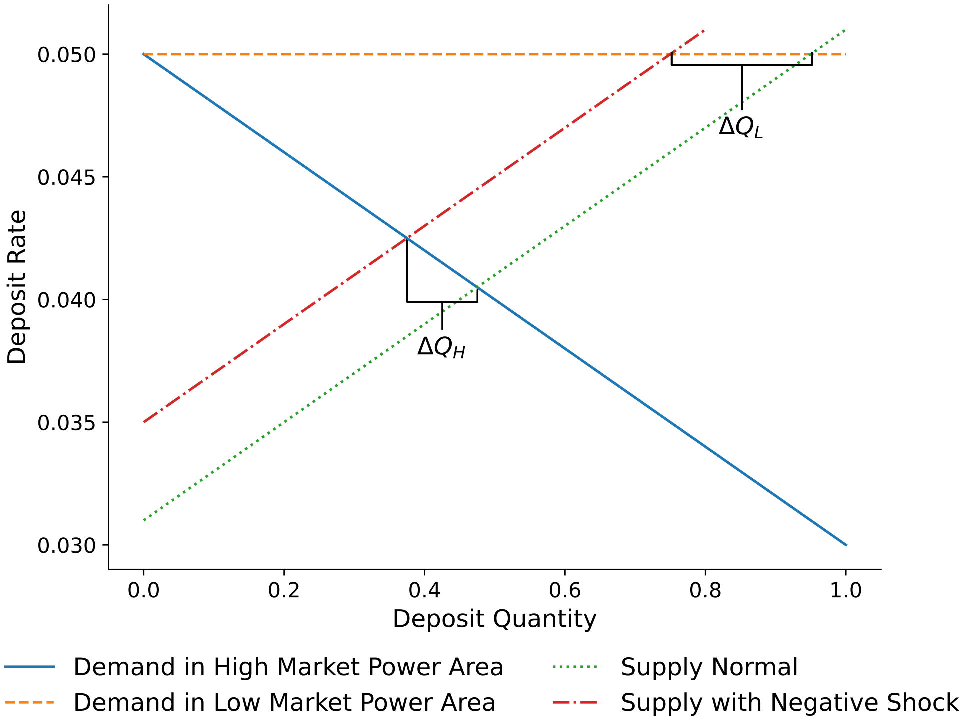

Figure 4: Identification Challenges — Heterogeneous Supply Shiftings. This figure illustrates the identification challenge of heterogeneous supply shiftings. The solid line is the deposit demand curve in both the high and low bank market power areas, so market power is assumed to be independent of the slope of the demand curve; the dashed line is the deposit supply curve under normal conditions; the dotted line is the deposit supply curve in the high bank market power area after good stock market performance; and the dash-dotted line is the deposit supply curve in the low bank market power area after good stock market performance.

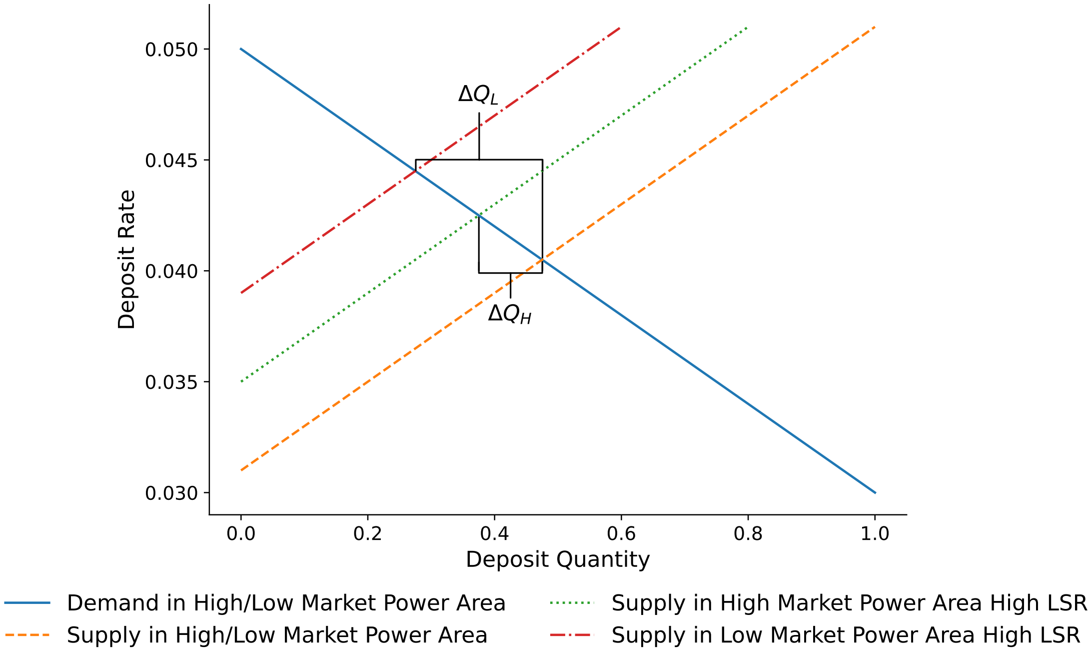

Figure 5: Identification Challenges — Heterogeneous Demand Shiftings. This figure illustrates the identification challenge of heterogeneous demand shiftings. The solid line is the deposit demand curve in both the high and low bank market power areas under normal conditions; the dashed line is the deposit supply curve in both the high and low bank market power areas; the dotted line is the deposit demand curve in the high bank market power area after good stock market performance; and the dash-dotted line is the deposit demand curve in the low bank market power area after good stock market performance.

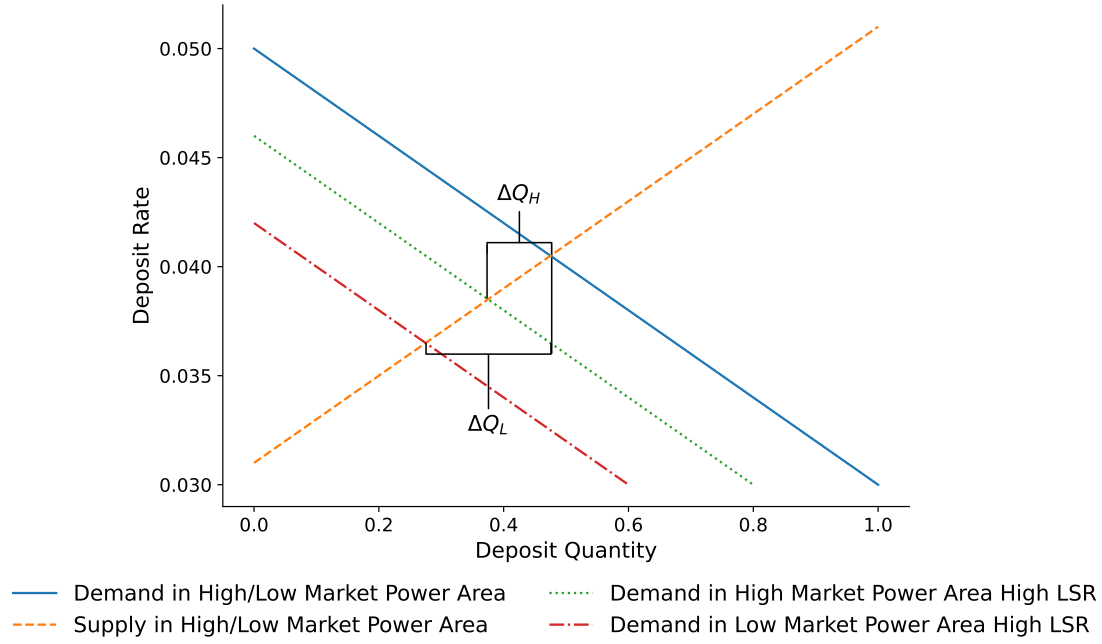

Figure 6: The Deposit Channel of Monetary Policy. This figure visualizes our findings against the deposit channel of monetary policy. We collect city level deposit quantity and price data and construct city level deposit growth and Herfindahl index. Then for each year t, we sort all cities into 10 deciles. Panel A plots the sensitivity of deposit growth rate to lagged Sharpe ratio (β^q_{LSR}) and change in Fed Funds rate (β^q_{FF}) from regression Equation 10 against HHI deciles; and Panel B plots the sensitivity of change in deposit yield to lagged Sharpe ratio (β^p_{LSR}) and change in Fed Funds rate (β^p_{FF}) from regression Equation 11 against HHI deciles.

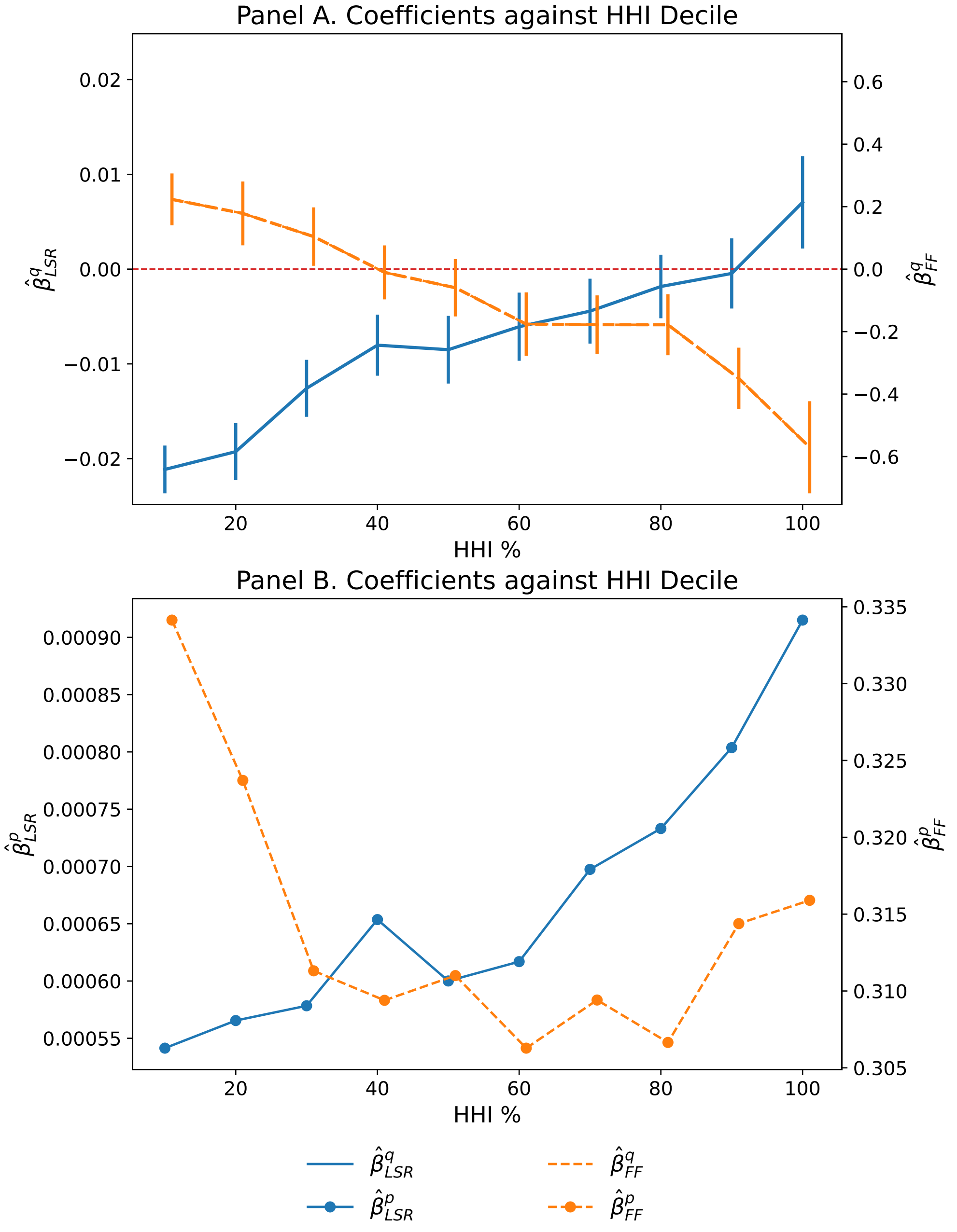

Figure 7: Does the Effect Aggregate? This figure plots the time series of lagged Sharpe ratio of the S&P 500 index (solid line in both subplots), together with the aggregate deposit growth rate (50% of aggregate deposit in the low HHI cities in Panel A, and 50% of aggregate deposit in the high HHI cities in Panel B).

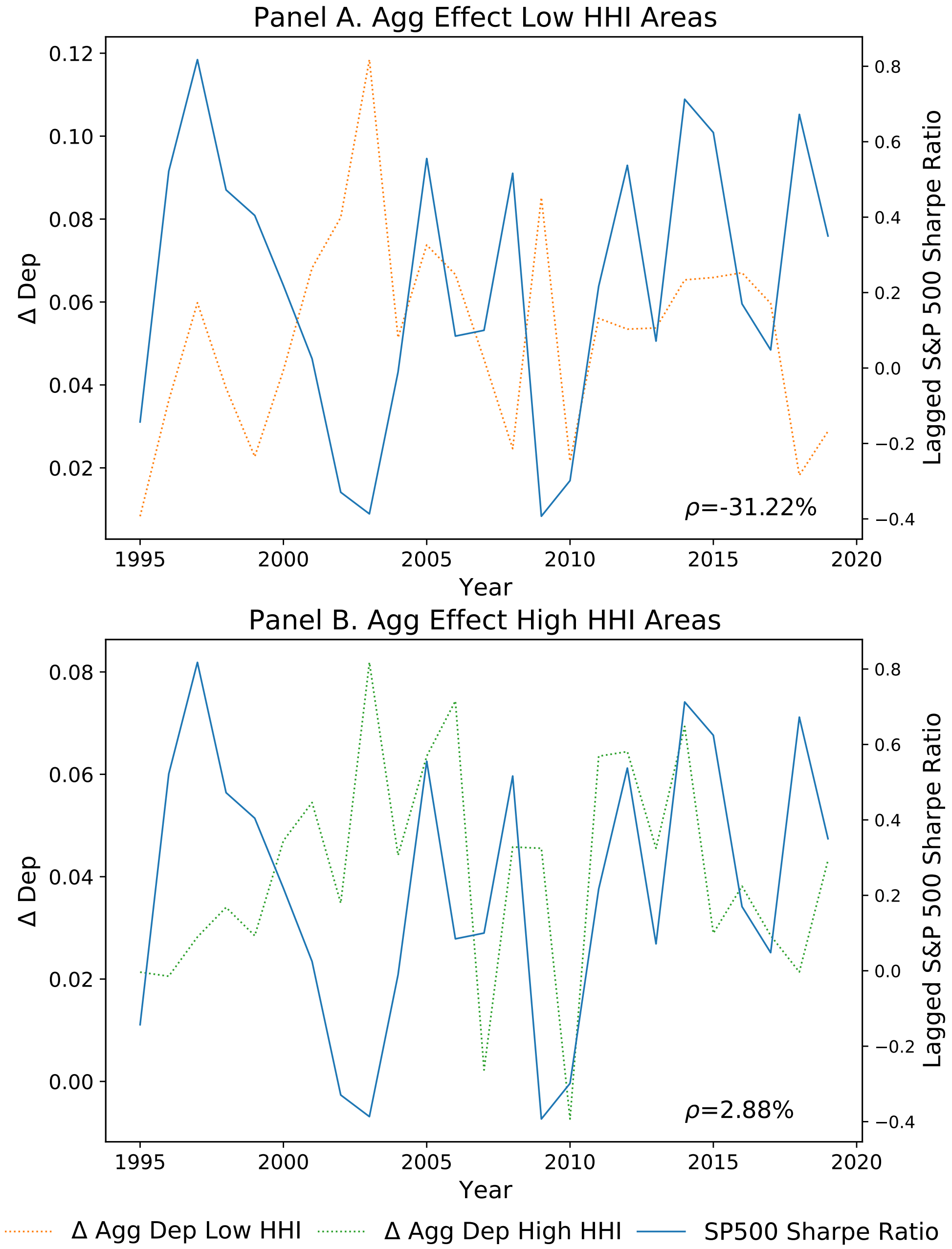

Table 1: Summary Statistics. This table presents the summary statistics of key variables at aggregate level (Panel A); city level (Panel B); county level (Panel C); branch level (Panel D); bank-city level (Panel E); bank-county level (Panel F); branch level deposit pricing data (Panel G); and small business lending data (Panel H). Panel A is constructed from FRED data; Panel B-F are constructed from FDIC data; Panel G is constructed from Rate-Watch data; and Panel H is constructed from FFIEC-CRA data. Variable definitions can be found in Table A.1.

	N	Mean	SD	P25	Median	P75
Panel A. Macro Time Series (Monthly)						
LSR	312	0.223	0.378	0.004	0.243	0.412
FF (%)	312	-0.033	1.331	-0.465	0.030	0.750
Panel B. City Level Deposit (Yearly)						
DDep	384,669	0.035	0.111	-0.013	0.030	0.077
LBranchHHI	384,669	0.628	0.349	0.297	0.578	1.000
LBankHHI	384,669	0.648	0.331	0.335	0.594	1.000
LDep ($ Millions)	384,669	437.218	6279.013	19.720	56.227	197.219
Panel C. County Level Deposit (Yearly)						
DDep	79,785	0.032	0.063	0.000	0.030	0.061
LBranchHHI	79,780	0.446	0.255	0.251	0.403	0.588
LBankHHI	79,780	0.481	0.234	0.302	0.435	0.603
LDep ($ Millions)	79,785	2103.316	1.5e+04	137.298	319.737	796.578
Panel D. Branch Level Deposit (Yearly)						
DDep	1,962,765	0.079	0.237	-0.027	0.039	0.122
LDep ($ Millions)	1,962,765	78.999	1210.892	16.254	33.335	63.293
Panel E. Bank-City Level Deposit (Yearly)						
DDep	1,232,006	0.075	0.224	-0.024	0.038	0.115
LDep ($ Millions)	1,232,006	129.705	1849.033	18.317	38.096	80.934
Panel F. Bank-County Level Deposit (Yearly)						
DDep	619,459	0.079	0.230	-0.020	0.038	0.113
LDep ($ Millions)	619,459	258.980	2689.594	24.253	55.231	131.663
Panel G. Rate Watch Branch Level Deposit Rate (Monthly)						
DAPY (%)	20,323,640	-0.122	0.611	-0.320	0.000	0.000
LDep ($ Millions)	22,447,966	922.158	6600.387	59.374	129.687	331.116
Panel H. County Level Community Reinvestment Act (CRA, Yearly)						
LoanAmt	67,810	7.929	2.165	6.512	7.963	9.429
LoanNum	67,810	4.371	1.724	3.135	4.304	5.537

Table 2: Heterogeneous Supply Shiftings — Quantity. This table presents the regression results of the following model:

$$\Delta Dep_{mnt} = \alpha_m + \mu_{nt} + \delta^q HHI_{mt-1} \times SR_{t-1} + \beta HHI_{mt-1} + controls + \varepsilon_{mnt},$$

where m indexes geographic level (city or county); n indexes geographic-parent level (county or state, respectively); and t indexes year. ΔDep_{mnt} is the log deposit growth rate in geographic area m from year $t-1$ to year t; α_m stands for geographic fixed effects; μ_{nt} stands for geographic-parent×year fixed effects; HHI_{mt-1} is the Herfindahl index in geographic area m at the end of year $t-1$; and SR_{t-1} is the lagged Sharpe ratio of the S&P 500 index through year $t-1$. We cluster standard errors at the respective geographic-parent level.

VARIABLES	(1) DDep	(2) DDep	(3) DDep	(4) DDep
LSR_HHI	0.008***	0.009***	0.017***	0.018***
	(0.002)	(0.002)	(0.004)	(0.004)
HHI	-0.033***	-0.039***	-0.002	-0.007
	(0.005)	(0.005)	(0.008)	(0.008)
LSize	-0.117***	-0.118***	-0.071***	-0.071***
	(0.003)	(0.003)	(0.005)	(0.005)
Observations	369,081	369,081	79,650	79,650
R-squared	0.347	0.347	0.241	0.241
Geo Level	City	City	County	County
HHI Level	Branch-City	Bank-City	Branch-County	Bank-County
Cluster/Parent Level	County	County	State	State
Geo FEs	Y	Y	Y	Y
Geo-Parent×Year FEs	Y	Y	Y	Y

Table 3: Heterogeneous Supply Shiftings — Price. This table presents regression results of the following price regression with geographic-parnet×month fixed effects corresponding to our quantity specification Equation 4:

$$\Delta APY_{ijmnklt} = \alpha_{iml} + \mu_{nt} + \delta^{p} HHI_{mt-12} \times SR_{t-12} + \beta HHI_{mt-12} + controls + \varepsilon_{ijmnklt},$$

where i indexes entity (branch or bank); j indexes entity-parent (bank or BHC, respectively); m indexes geographic level (city or county); n indexes geographic parent (county or state, respectively); k indexes branch; l indexes deposit product; and t indexes month. $\Delta APY_{ijmnklt}$ is the change in the annul percentage yield of product l provided by branch k from month $t-12$ to t; α_{iml} stands for entity×geographic×product fixed effects; μ_{nt} stands for geographic-parent×month fixed effects; HHI_{mt-12} is the Herfinahl index in geographic area m at the end of previous year; and SR_{t-12} is the Sharpe ratio of the S&P index at the end of month $t-12$. We two way cluster the standard errors at entity-parent and geographic-parent level.

VARIABLES	(1) DAPY	(2) DAPY	(3) DAPY	(4) DAPY
LSR_HHI	0.018***	0.019***	0.013	0.013
	(0.006)	(0.006)	(0.010)	(0.010)
HHI	-0.018	-0.034*	-0.027*	-0.022
	(0.018)	(0.018)	(0.014)	(0.017)
LSize	-0.006**	-0.018***	-0.009***	-0.025***
	(0.003)	(0.005)	(0.003)	(0.005)
Observations	20,298,182	20,298,592	20,278,957	20,280,234
R-squared	0.750	0.749	0.705	0.702
Entity Level	Branch	Bank	Branch	Bank
Geo Level	City	City	County	County
HHI Level	Branch-City	Bank-City	Branch-County	Bank-County
Cluster/Parent Level	Bank County	BHC County	Bank State	BHC State
Entity×Geo×Product FEs	Y	Y	Y	Y
Geo-Parent×Month FEs	Y	Y	Y	Y

Table 4: Heterogeneous Demand Shiftings — Quantity. This table presents the regression results of the following entity level regression with entity-parent×geographic-parent×year fixed effects:

$$\Delta \log Dep_{ijmnt} = \alpha_{im} + \mu_{jnt} + \delta^q HHI_{mt-1} \times SR_{t-1} + \beta HHI_{mt-1} + controls + \varepsilon_{ijmnt},$$

where i indexes entity (branch or bank); j indexes entity parent (bank or BHC, respectively); m indexes geographic area (city or county); n indexes geographic parent (county of state, respectively); and t indexes year. $\Delta \log Dep_{ijmnt}$ is the log deposit growth rate of entity i in geographic area m from year $t-1$ to year t; α_{im} stands for entity×geographic fixed effects; μ_{jnt} stands for entity-parent×geographic-parent×year fixed effects; HHI_{mt-1} is the Herfindahl index in geographic area m at the end of year $t-1$; and SR_{t-1} is the S&P 500 Sharpe ratio in year $t-1$. We two-way cluster standard errors at entity-parent and geographic-parent level.

	(1)	(2)	(3)	(4)
VARIABLES	DDep	DDep	DDep	DDep
LSR_HHI	0.007***	0.013***	0.013***	0.016**
	(0.002)	(0.003)	(0.005)	(0.007)
HHI	0.033***	0.048***	0.004	0.041***
	(0.005)	(0.010)	(0.009)	(0.010)
LSize	-0.291***	-0.270***	-0.293***	-0.249***
	(0.006)	(0.005)	(0.006)	(0.008)
Observations	1,634,154	914,566	1,853,199	543,870
R-squared	0.665	0.667	0.612	0.611
Entity Level	Branch	Bank	Branch	Bank
Geo Level	City	City	County	County
HHI Level	Branch-City	Bank-City	Branch-County	Bank-County
Cluster/Parent Level	Bank County	BHC County	Bank State	BHC State
Entity×Geo FEs	Y	Y	Y	Y
Parent×Parent×Year FEs	Y	Y	Y	Y

Table 5: Demand Shock? — Quantity. This table presents the regression results of the following quantity regression:

$$\Delta Dep_{mnt} = \alpha_m + \beta^q SR_{t-1} + \delta^q HHI_{mt-1} \times SR_{t-1} + \beta HHI_{mt-1} + controls + \varepsilon_{mnt},$$

where m indexes geographic level (city or county); n indexes geographic-parent level (county or state, respectively); and t indexes year. ΔDep_{mnt} is the log deposit growth rate in geographic area m from year $t-1$ to year t; α_m stands for geographic fixed effects; HHI_{mt-1} is the Herfindahl index in geographic area m at the end of year $t-1$; and SR_{t-1} is the lagged Sharpe ratio of the S&P 500 index through year $t-1$. We cluster standard errors at the respective geographic-parent level.

	(1)	(2)	(3)	(4)
VARIABLES	DDep	DDep	DDep	DDep
LSR	-0.014***	-0.015***	-0.013***	-0.015***
	(0.001)	(0.001)	(0.002)	(0.002)
LSR_HHI	0.016***	0.017***	0.026***	0.027***
	(0.002)	(0.002)	(0.004)	(0.004)
HHI	-0.014***	-0.020***	-0.017**	-0.016**
	(0.004)	(0.004)	(0.008)	(0.007)
LSize	-0.078***	-0.079***	-0.038***	-0.038***
	(0.001)	(0.001)	(0.005)	(0.005)
Observations	384,537	384,537	79,766	79,766
R-squared	0.155	0.155	0.103	0.103
Geo Level	City	City	County	County
HHI Level	Branch-City	Bank-City	Branch-County	Bank-County
Cluster/Parent Level	County	County	State	State
Geo FEs	Y	Y	Y	Y

Table 6: Demand Shock? — Price. This table presents the regression results of the following price regression:

$$\begin{aligned}\Delta APY_{ijmnklt} =& \alpha_{iml} + \beta^{p} SR_{t-12} + \delta^{p} HHI_{mt-12} \times SR_{t-12} \\ &+ \beta HHI_{mt-12} + controls + \varepsilon_{ijmnklt},\end{aligned}$$

where i indexes entity (branch or bank); j indexes entity-parent (bank or BHC, respectively); m indexes geographic level (city or county); n indexes geographic parent (county or state, respectively); k indexes branch; l indexes deposit product; and t indexes month. $\Delta APY_{ijmnklt}$ is the change in the annul percentage yield of product l provided by branch k from month $t-12$ to t; α_{iml} stands for entity×geographic×product fixed effects; HHI_{mt-12} is the Herfinahl index in geographic area m at the end of previous year; and SR_{t-12} is the Sharpe ratio of the S&P index at the end of month $t-12$. We two way cluster the standard errors at entity-parent and geographic-parent level.

VARIABLES	(1) DAPY	(2) DAPY	(3) DAPY	(4) DAPY
LSR	0.323***	0.307***	0.317***	0.301***
	(0.008)	(0.009)	(0.010)	(0.013)
LSR_HHI	0.054***	0.056***	0.081***	0.090***
	(0.010)	(0.013)	(0.017)	(0.023)
HHI	0.252**	0.223*	0.175	0.213
	(0.110)	(0.126)	(0.152)	(0.174)
LSize	-0.018**	0.069***	-0.016	0.072***
	(0.007)	(0.010)	(0.011)	(0.014)
Observations	20,298,229	20,298,639	20,278,959	20,280,236
R-squared	0.171	0.164	0.171	0.158
Entity Level	Branch	Bank	Branch	Bank
Geo Level	City	City	County	County
HHI Level	Branch-City	Bank-City	Branch-County	Bank-County
Cluster/Parent Level	Bank County	BHC County	Bank State	BHC State
Entity×Geo×Product FEs	Y	Y	Y	Y

Table 7: Summary of Main Findings. This table presents a summary of the main findings. Panel A presents the three hypotheses: (1) bank market power steepening demand curve hypothesis; (2) heterogeneous supply curve shiftings hypothesis; and (3) heterogeneous demand curve shiftings hypothesis, together with their respective quantity and price predictions. Panel B presents a summary of empirical findings.

	δ^q	δ^p	β^q	β^p
Panel A. Hypotheses				
Market Power Steepening Demand Slope	+	+	-	+
Heterogeneous Supply Shiftings	+	-	-	+
Heterogeneous Demand Shiftings	+	+	-	-
Panel B. Summary of Main Findings				
Combined Main Findings	+	+	-	+
Equation 4	+			
Equation 5 (Contradicting Heterogeneous Supply Shiftings)		+		
Equation 6	+			
Equation 7 (No Significant Evidence)		NA		
Equation 8			-	
Equation 9 (Contradicting Heterogeneous Demand Shiftings)				+

Table 8: Deposit Channel of Monetary Policy — Quantity. This table presents the regression results of the following quantity regression:

$$\begin{aligned}\Delta \log Dep_{ijmnt} =&\alpha_{im} + \mu_{jnt} + \delta^q_{LSR} HHI_{mt-1} \times SR_{t-1} + \delta^q_{FF} HHI_{mt-1} \times FF_t \\ &+ \beta HHI_{mt-1} + controls + \varepsilon_{ijmnt},\end{aligned}$$

where i indexes entity (branch or bank); j indexes entity parent (bank or BHC, respectively); m indexes geographic area (city or county); n indexes geographic parent (county of state, respectively); and t indexes year. $\Delta \log Dep_{ijmnt}$ is the log deposit growth rate of entity i in geographic area m from year $t-1$ to year t; α_{im} stands for entity×geographic fixed effects; μ_{jnt} stands for entity-parent×geographic-parent×year fixed effects; HHI_{mt-1} is the Herfindahl index in geographic area m at the end of year $t-1$; SR_{t-1} is the S&P 500 Sharpe ratio in year $t-1$; and FF_t is the change of Fed Funds rate from year $t-1$ to t as in Drechsler et al. (2017). We two-way cluster standard errors at entity-parent and geographic-parent level.

VARIABLES	(1) DDep	(2) DDep	(3) DDep	(4) DDep
LSR_HHI	0.008***	0.013***	0.016***	0.021***
	(0.002)	(0.003)	(0.005)	(0.007)
FF_HHI	-0.111	-0.117	-0.528***	-0.812***
	(0.070)	(0.092)	(0.133)	(0.154)
HHI	0.032***	0.047***	0.003	0.039***
	(0.005)	(0.010)	(0.010)	(0.010)
LSize	-0.291***	-0.270***	-0.293***	-0.249***
	(0.006)	(0.005)	(0.006)	(0.008)
Observations	1,634,154	914,566	1,853,199	543,870
R-squared	0.665	0.667	0.612	0.611
Entity Level	Branch	Bank	Branch	Bank
Geo Level	City	City	County	County
HHI Level	Branch-City	Bank-City	Branch-County	Bank-County
Cluster/Parent Level	Bank County	BHC County	Bank State	BHC State
Entity×Geo FEs	Y	Y	Y	Y
Parent×Parent×Year FEs	Y	Y	Y	Y

Table 9: Does the Effect Aggregate? In each year t, we aggregate all city level deposit into 100 groups based on HHI level. This table presents the regression results of the following quantity regression:

$$\Delta Dep_{gt} = \alpha_g + \mu_t + \delta HHI_{gt-1} \times SR_{t-1} + \beta HHI_{gt-1} + controls + \varepsilon_{gt},$$

where g indexes group; and t indexes year. α_g and μ_t stand for group fixed effects and year fixed effects, respectively. ΔDep_{gt} is the aggregate deposit growth rate of cities within group g from year $t-1$ to year t; HHI_{gt-1} is the weighted average Herfindahl index of cities within group g; and SR_{t-1} is the lagged Sharpe ratio of the S&P 500 index. We cluster standard errors at the group level.

VARIABLES	(1) DDep	(2) DDep
LSR_HHI	0.060**	0.060**
	(0.026)	(0.029)
HHI	-0.070	0.024
	(0.062)	(0.083)
LSize	0.010***	0.009***
	(0.003)	(0.003)
Observations	2,233	2,231
R-squared	0.142	0.136
HHI Level	Agg Branch-City	Agg Bank-City
Cluster Level	Group	Group
Group FEs	Y	Y
Year FEs	Y	Y

Table 10: Real Effects (Branch-County HHI). This table presents the regression results of the following lending regression:

$$\log(1 + Loan_{mnt}) = \alpha_m + \mu_{nt} + \delta HHI_{mt-1} \times SR_{t-1} + \beta HHI_{mt-1} + controls + \varepsilon_{mnt},$$

where m indexes county; n indexes state; and t indexes year. $\log(1 + Loan_{mnt})$ is either the log amount of small business lending or the log number of small business lending in county m in year t. α_m stands for county fixed effects; μ_{nt} stands for state×year fixed effects; HHI_{mt-1} is the Herfindahl index in county m at the end of year $t-1$; and SR_{t-1} is the S&P 500 Sharpe ratio in year $t-1$. We cluster standard errors at the state level.

VARIABLES	(1) LoanAmt	(2) LoanAmt	(3) LoanNum	(4) LoanNum
LSR	-0.205***		-0.535***	
	(0.046)		(0.046)	
LSR_HHI	0.299***	0.014	0.409***	0.121***
	(0.064)	(0.038)	(0.068)	(0.023)
HHI	-0.393	-0.210*	-0.232	-0.180**
	(0.273)	(0.109)	(0.303)	(0.068)
LSize	0.126*	0.172***	-0.872***	0.083***
	(0.063)	(0.048)	(0.076)	(0.025)
Observations	67,682	67,611	67,682	67,611
R-squared	0.822	0.868	0.771	0.935
Geo Level	County	County	County	County
HHI Level	Branch-County	Branch-County	Branch-County	Branch-County
Cluster/Parent Level	State	State	State	State
County FEs	Y	Y	Y	Y
State×Year FEs	N	Y	N	Y

A Additional Results

Table A.1: Variable Definitions.

Variable	Definition
LSR	Lagged Sharpe ratio of the S&P 500 index
FF	Change in Fed Funds rate
DDep	log deposit growth rate
LBranchHHI	Branch level Herfindahl index
LBankHHI	Bank level Herfindahl index
LDep	Lagged deposit amount
DAPY	12-month rolling change in the annual percentage yield
LoanAmt	log 1 plus the amount of small business loans originated
LoanNum	log 1 plus the number of small business loans originated

Table A.2: Replication of Table 3 in Drechsler et al. (2017). This table reports the replications of Table 3 in Drechsler et al. (2017) by their replication kit (Panel A) and our data and code (Panel B). In our replication, we use effective Fed Funds rate instead of target Fed Funds rate. The correlation between our HHI measure and theirs is over 0.9.

Panel A. Replication by Their Replication Kit

VARIABLES	(1) DDep	(2) DDep	(3) DDep	(4) DDep	(5) DDep	(6) DDep
FF_HHI	-1.827***	-1.796***	-0.963***	-0.661***	-1.008***	-0.827***
	(0.198)	(0.242)	(0.212)	(0.254)	(0.331)	(0.247)
Observations	1,310,111	1,310,111	1,310,111	1,150,049	1,150,049	1,150,093
R-squared	0.230	0.221	0.025	0.344	0.336	0.025
County Post FEs	Y	Y	Y	Y	Y	Y
Branch FEs	Y	Y	N	Y	Y	N
State Year FEs	Y	N	N	Y	N	N
Bank Year FEs	N	N	N	Y	Y	N
Year FEs	N	Y	Y	N	N	Y

Panel B. Replication by Our Data and Code

VARIABLES	(1) DDep	(2) DDep	(3) DDep	(4) DDep	(5) DDep	(6) DDep
FF_HHI	-2.473***	-1.871***	-0.951***	-1.194***	-0.745*	-0.752***
	(0.275)	(0.315)	(0.238)	(0.359)	(0.387)	(0.274)
Observations	1,264,166	1,264,167	1,457,799	1,121,157	1,121,158	1,247,945
R-squared	0.210	0.205	0.014	0.306	0.301	0.015
County Post FEs	Y	Y	Y	Y	Y	Y
Branch FEs	Y	Y	N	Y	Y	N
State Year FEs	Y	N	N	Y	N	N
Bank Year FEs	N	N	N	Y	Y	N
Year FEs	N	Y	Y	N	N	Y

Table A.3: Heterogeneous Demand Shiftings — Price. This table presents the regression results of the following price regression with entity-parent×geographic-parent× month fixed effects:

$$\Delta APY_{ijmnklt} = \alpha_{iml} + \mu_{jnt} + \delta^{p} HHI_{mt-12} \times SR_{t-12} + \beta HHI_{mt-12} + controls + \varepsilon_{ijmnklt},$$

where i indexes entity (branch or bank); j indexes entity-parent (bank or BHC, respectively); m indexes geographic level (city or county); n indexes geographic parent (county or state, respectively); k indexes branch; l indexes deposit product; and t indexes month. $\Delta APY_{ijmnklt}$ is the change in the annul percentage yield of product l provided by branch k from month $t-12$ to t; α_{iml} stands for entity×geographic×product fixed effects; μ_{jnt} stands for entity-parent×geographic-parent×month fixed effects; HHI_{mt-12} is the Herfinahl index in geographic area m at the end of previous year; and SR_{t-12} is the Sharpe ratio of the S&P index at the end of month $t-12$. We two way cluster the standard errors at entity-parent and geographic-parent level.

	(1)	(2)	(3)	(4)
VARIABLES	DAPY	DAPY	DAPY	DAPY
LSR_HHI	0.053*	0.003	-0.013*	-0.009
	(0.031)	(0.022)	(0.008)	(0.006)
HHI	-0.009	-0.020	-0.003	-0.027
	(0.134)	(0.038)	(0.028)	(0.033)
LSize	-0.020	-0.031***	-0.002	-0.033***
	(0.019)	(0.002)	(0.002)	(0.003)
Observations	20,297,841	20,298,403	20,278,655	20,280,176
R-squared	0.816	0.811	0.808	0.788
Entity Level	Branch	Bank	Branch	Bank
Geo Level	City	City	County	County
HHI Level	Branch-City	Bank-City	Branch-County	Bank-County
Cluster/Parent Level	Bank County	BHC County	Bank State	BHC State
Entity×Geo×Product FEs	Y	Y	Y	Y
Parent×Parent×Month FEs	Y	Y	Y	Y

Table A.4: Main Results — Excess Return as Supply Shock. This table presents the regression results of the following entity level regression with entity-parent×geographic-parent×year fixed effects:

$$\Delta \log Dep_{ijmnt} = \alpha_{im} + \mu_{jnt} + \delta^q HHI_{mt-1} \times XR_{t-1} + \beta HHI_{mt-1} + controls + \varepsilon_{ijmnt},$$

where i indexes entity (branch or bank); j indexes entity parent (bank or BHC, respectively); m indexes geographic area (city or county); n indexes geographic parent (county of state, respectively); and t indexes year. $\Delta \log Dep_{ijmnt}$ is the log deposit growth rate of entity i in geographic area m from year $t-1$ to year t; α_{im} stands for entity×geographic fixed effects; μ_{jnt} stands for entity-parent×geographic-parent×year fixed effects; HHI_{mt-1} is the Herfindahl index in geographic area m at the end of year $t-1$; and XR_{t-1} is the excess return of the S&P 500 index in year $t-1$. We two-way cluster standard errors at entity-parent and geographic-parent level.

VARIABLES	(1) DDep	(2) DDep	(3) DDep	(4) DDep
LXR_HHI	0.025***	0.041***	0.044***	0.059***
	(0.005)	(0.006)	(0.011)	(0.012)
HHI	0.033***	0.049***	0.005	0.042***
	(0.005)	(0.010)	(0.009)	(0.010)
LSize	-0.291***	-0.270***	-0.293***	-0.249***
	(0.006)	(0.005)	(0.006)	(0.008)
Observations	1,634,154	914,566	1,853,199	543,870
R-squared	0.665	0.667	0.612	0.611
Entity Level	Branch	Bank	Branch	Bank
Geo Level	City	City	County	County
HHI Level	Branch-City	Bank-City	Branch-County	Bank-County
Cluster/Parent Level	Bank County	BHC County	Bank State	BHC State
Entity×Geo FEs	Y	Y	Y	Y
Parent×Parent×Year FEs	Y	Y	Y	Y

Table A.5: Real Effects (Bank-County HHI). This table presents the regression results of the following lending regression:

$$\log(1 + Loan_{mnt}) = \alpha_m + \mu_{nt} + \delta HHI_{mt-1} \times SR_{t-1} + \beta HHI_{mt-1} + controls + \varepsilon_{mnt},$$

where m indexes county; n indexes state; and t indexes year. $\log(1 + Loan_{mnt})$ is either the log amount of small business lending or the log number of small business lending in county m in year t. α_m stands for county fixed effects; μ_{nt} stands for state×year fixed effects; HHI_{mt-1} is the Herfindahl index in county m at the end of year $t-1$; and SR_{t-1} is the S&P 500 Sharpe ratio in year $t-1$. We cluster standard errors at the state level.

VARIABLES	(1) LoanAmt	(2) LoanAmt	(3) LoanNum	(4) LoanNum
LSR	-0.204***		-0.537***	
	(0.049)		(0.050)	
LSR_HHI	0.272***	0.012	0.382***	0.114***
	(0.068)	(0.041)	(0.075)	(0.024)
HHI	-0.372	-0.255**	-0.018	-0.217***
	(0.274)	(0.109)	(0.303)	(0.070)
LSize	0.127**	0.172***	-0.863***	0.083***
	(0.063)	(0.048)	(0.076)	(0.025)
Observations	67,682	67,611	67,682	67,611
R-squared	0.822	0.868	0.771	0.935
Geo Level	County	County	County	County
HHI Level	Bank-County	Bank-County	Bank-County	Bank-County
Cluster/Parent Level	State	State	State	State
County FEs	Y	Y	Y	Y
State×Year FEs	N	Y	N	Y