Diverging Banking Sector: New Facts and Macro Implications*

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Abstract

We document the emergence of two distinct types of banks over the past decade: high rate banks, which align deposit rates with market interest rates, hold shorter-term assets, and primarily earn lending spreads by taking more credit risks through personal and business loans; and low rate banks, which offer interest-insensitive, low deposit rates, hold a larger proportion of long-term securities (e.g., MBS), and make fewer loans. This divergence in the banking sector leads to a significant shift of deposits towards high rate banks as interest rates rise, thereby reducing the sector's overall capacity for maturity transformation and increasing its exposure to credit risk, particularly through personal loans. Our evidence suggest that technological advancements in banking contributed to the divergence: high rate banks operate primarily online and attract less sticky depositors. In response, low rate banks lower rates through the retention of relatively stickier depositors.

Keywords: banking, monetary policy, interest rate risk, credit risk

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1 Introduction

Heterogeneity in deposit rates across banks has increased substantially over the past 15 years. For example, consider the largest banks by total deposits as of 2023, shown in Table 1. JP Morgan Chase, US Bank, Wells Fargo and Bank of America pay virtually zero interest on savings accounts, while PNC, Marcus, Citi, Ally, and Capital One pay nearly 450 basis points. This heterogeneity in deposit rates is a new feature – in 2006, when interest rates were similar to today, the difference between the 75th and 25th percentiles of deposit rates among the largest 25 banks was around 70 bps, whereas today it is around 350 bps. The distribution in deposit rates today is bimodal so that there are effectively two types of banks driving this result: high rate banks, which offer deposit rates that are near market interest rates, and low rate banks, which all pay similar deposit rates that are very insensitive to market interest rates.

These two types of banks have diverged in the last 10 to 15 years not only in the deposit rates they offer but also in their distinct business models. To show this, we initially focus on the largest 25 banks, following the definition of large banks in the Federal Reserve's H.8 report, and define those ranked in the top quintile by deposit rates as high rate banks.[1] High rate banks operate far fewer physical branches and engage far less in maturity transformation – they reduce long-term real estate loans and hold shorter maturity securities that match the duration of their deposits. These banks earn larger lending spread by taking on greater credit risks, primarily through personal and commercial and industrial (C&I) lending. As high rate banks become more prominent over the last 10 to 15 years, we simultaneously see significant changes in the behavior of low rate banks. In particular, they offer deposit rates that are lower and far *less* sensitive to changes in interest rates than before, and they substantially shift their asset allocation from lending to firms and households towards holding safe and long-duration securities (e.g., mortgage backed securities).

Recognizing the emergence of these two types of banks is critical for understanding the transmission of monetary policy and the banking sector's capacity for maturity transformation, along with its ability to provide liquidity and credit going forward. Monetary policy affects the deposit distribution between these two types of banks: when rates rise, the rate gap between high and low rate banks widens, prompting deposits to shift towards high rate banks. As high rate banks typically engage in lending at much shorter maturities – the average maturity on the asset side for high rate banks is 2.5 years lower than for low rate banks – increases in interest rates lowers the extent of maturity transformation performed by the banking sector. At the same time, high rate banks lend more to consumers and businesses, thereby assuming greater credit risk. If the trend of deposits shifting towards high rate banks persists, particu-

[1] Our main focus on the largest 25 banks is for several reasons. First, we adhere to the Federal Reserve's definition of large banks, as outlined here, with one key distinction: we focus on the bank holding company. This approach is adopted because we also investigate the market leverage of banks in some analyses, where equity valuation is typically calculated at the bank holding company level. Our results remain robust when we conduct the analysis at the individual bank level. Second, these banks make up 70% of aggregate bank assets due to a highly skewed size distribution, and thus the largest banks are disproportionately important for speaking to aggregate lending. Third, small banks are regulated very differently than large banks in our sample. Fourth, as shown by d'Avernas et al. (2023), small banks and large banks have different business models throughout the sample, while we show large banks behave very similar before 2009. We show our results are robust when extending the analysis to include the top 100 banks which account for 85% of total bank assets.

larly in an environment of sustained high interest rates, the banking sector's ability to absorb duration risk is expected to decrease significantly.[2] Simultaneously, credit risk will become increasingly concentrated within high rate banks. This trend is more likely to continue if interest rates remain elevated and if depositors increasingly prefer mobile and online banking rather than physical branches.

What explains the emergence of these two types of banks? Our findings consistently support the technology mechanism, which is firstly proposed and causally identified by Jiang, Yu and Zhang (2022). They show that digital disruption, which enables banks to operate without physical branches, can lead to a divergence in branch operation strategies and deposit rate setting among banks.[3] Consistently, we document since 2009, high rate banks have seen an additional 65% reduction in the number of branches compared to low rate banks, and the ratio of branches to total deposits has declined by approximately 37%. Furthermore, high rate banks invest more in IT compared to low rate banks and they tend to locate their smaller number of branches in demographically younger counties, suggesting that they have younger customers. Because high rate banks appear to have lower costs and potentially face stronger competition that is less dependent on location, they offer higher deposit rates that are closer to market interest rates. However, because they offer rates that vary significantly with market interest rates, these banks hold significantly lower duration assets. While they earn a small but positive deposit spread between market interest rates and deposit rates (generating a small franchise value of deposits), they take more credit risk on the asset side rather than interest rate risk to secure a high net interest margin. The average credit spread earned by high rate banks (loan rates minus maturity matched Treasury yields) is around 200 bps higher than that of low rate banks over the last decade. Charge-offs on loans and leases for high rate banks are also about double that of low rate banks over the past decade.

While the observed emergence of heterogeneity in the banking sector is partly due to the rise of high rate banks, a significant portion also stems from low rate banks behaving quite differently than they used to. For example, low rate banks used to have a deposit rate sensitivity of around 0.5, and this number has fallen to around 0.1 for the 2018 and 2022 rate hiking cycles. That is, for every 100 bps increase in the Federal funds rate, low rate banks pass along only 10 bps to depositors vs. 50 bps before. In turn, their deposits act more like fixed rate liabilities, and hence these banks hold *longer* duration and safe securities than they previously did. One potential explanation is that as some banks transition to operating online, low rate banks that maintain physical branches are left with stickier depositor bases and/or depositors who highly value in-person banking services. This allows them to charge higher markups in the form of even lower deposit rates that are insensitive to fluctuations in market interest rates. Second, as low rate banks in our sample offer both online services and physical branches, they

[2] Drechsler, Savov and Schnabl (2021) discuss how the sensitivity of deposit rates to the Federal funds rate interacts with banks' ability to take maturity risk.

[3] Specifically, Jiang, Yu and Zhang (2022) show that the rollover of 3G network infrastructure results in the divergence in deposit rate strategies among banks. The study finds that, following the 3G expansion, banks with reduced reliance on branches close branches and target tech-savvy customers, while banks maintaining a strong branch network pivot towards serving branch-captive consumers. Consequently, the former group offers higher deposit rates to attract tech-savvy consumers, while the latter group offers lower rates, extracting rents from branch-captive consumers.

may incur higher marginal costs, which compels them to offer lower deposit rates. However, when examining non-interest rate expense, we do not find evidence indicating higher cost.

To rationalize above findings, we provide a simple model in the style of Salop (1979) and Allen and Gale (2004). We analyze the strategies of two banks competing for deposits and determining loans with varying risk profiles. Depositors have a preference for in-person services and favor branches located in close proximity. In equilibrium, the two banks locate at opposite points on a circle, offer identical deposit rates, and earn rents from depositors' valuation of branch accessibility by offering deposit rates lower than the risk-free rate. We then introduce the option of "e-banking," a service model independent of physical location, allowing depositors to derive utility from features such as the convenience of mobile banking. In response to this new technology, both banks integrate e-banking into their service offerings. However, when operating branches is relatively costly, a divergent banking sector emerges; one bank transitions entirely to an e-banking model, raising its deposit rates to attract a broader base of depositors while yielding lower rents per depositor. In contrast, the other bank maintains its branches, catering to depositors who prioritize location, thus securing higher rents per depositor through relatively lower deposit rates. This generates a positive deposit spread between e-banks and branch banks, as in the data, and this spread drives deposit flows toward e-banks. Turning to the lending side, the bank that retains its branches chooses a less risky loan portfolio, aiming to safeguard the rents it earns from its depositors. Conversely, the e-bank, which gathers lower rents from its depositor base, pursues riskier loans to achieve higher lending rates. This divergence mirrors empirical trends in branch operations, deposit rates, and lending strategies.

The emergence of a diverging banking sector carries several significant macro implications. First, it affects how monetary policy is transmitted through the banking sector. A key aspect highlighted in the literature is that as interest rates increase, deposits flow from banks to money-market funds, leading to an aggregate contraction in bank lending (Drechsler, Savov and Schnabl, 2017). However, within a diverging banking sector, our analysis reveals a different dynamic: when interest rates rise, deposits disproportionately flow out of low rate banks. Given that these low rate banks primarily focus on lending to long-term but safe assets, like Treasuries and MBS, we show that a one percentage point increase in the Federal Funds rate causes these banks to reduce their MBS holdings by 4.9%. In contrast, lending to personal and C&I loans even increase by 1.2% and 1.7%, respectively for each one percentage point increase in the Federal Funds rate. This is because these types of loans are held by high rate banks, which are not adversely affected or may even receive more deposits when rates increase. We further confirm that these results are not driven by increased loan demand from households and firms, as the lending spread for these loans actually decreases while their quantity grows. This suggests that the dominant force is a relative expansion in credit supply from high rate banks. Collectively, these results not only confirm the divergence in the banking sector but also reveal that while tighter monetary policy leads low rate banks to reduce their securities holdings, it paradoxically prompts high rate banks to expand their credit offerings to consumers and small businesses.

This perspective also sheds light on why a significant credit crunch has not so far occurred during the recent rate hikes. Starting in 2022, the Federal Reserve sharply increased interest rates, and this was accompanied by annual deposit outflows of over 8%, the largest in percentage terms since the data begins in 1973. Despite these dramatic outflows, a credit crunch has so far no ensued. This outcome can be attributed to the rate hikes having disproportionately large effects on low rate banks, which resulted in a substantial reduction in their holdings of treasuries and agency MBS. Meanwhile, high rate banks were mildly affected, experiencing almost no deposit outflows, and thus their lending to consumers and businesses was not significantly impacted on an aggregate level. Moreover, deposit inflows and outflows can affect bank fragility and banks' deposit franchise value (Haddad, Hartman-Glaser and Muir, 2023; Drechsler et al., 2023). This has important implications for the design of regulatory policy.

Second, our paper urges a reevaluation of how bank risk is assessed. Our findings indicate that banks with diverging strategies exhibit distinct risk profiles: low rate banks are more vulnerable to interest rate risk, while high rate banks are more exposed to credit risk. Although both types of risk can precipitate bank runs, they manifest under different economic conditions. Interest rate risk becomes particularly acute during Federal Funds rate hikes, often associated with stronger economic periods, whereas credit risk escalates during economic downturns, which may trigger reductions in the Federal Funds rate. Current regulatory practices may not adequately consider this heterogeneity, which could have significant implications for systemic risk assessment and monetary interventions.

Third, as deposits shift from low rate to high rate banks, it alters the overall capacity of the banking sector to engage in maturity transformation and to provide loans to households and businesses. A back-of-the-envelope calculation indicates that with a 10% shift of deposits from low rate to high rate banks, the banking sector as a whole tends to originate loans and securities with maturities that are approximately 5% shorter and assumes about 20% higher credit risk. This redistribution not only affects the risk profile and hence the stability of the banking sector but also its fundamental ability to meet the maturity transformation needs of the economy.

Understanding this shift is particularly relevant today, as more banks opt to operate without physical branches and engage in fierce competition in deposit rate setting, driven by the preferences of younger customers who are more sensitive to rates and place less value on in-person banking services (Jiang, Yu and Zhang, 2022). As the banking sector increasingly adopts this model, the capacity for maturity transformation—a critical function in the financial system—could be substantially reduced.

It is worth highlighting that we focus on the largest 25 banks in our analysis, all of which offer online services. This distinguishes our work from prior research on digitization in banking, which typically focused on whether a bank offers online banking as a criterion to characterize digital banks. For example, Koont, Santos and Zingales (2023) characterize digital banks based on the number of reviews for the bank's mobile app in the app store. According to their definition, all of top 25 banks have widely used mobile apps and are thus considered digital. Further, while our study focuses on the top 25 banks by size, we show robustness of our main result to using the top 100 banks.

Overall, our evidence suggests that the growing divergence within the banking sector is connected to the advent of e-banking services. However, the rise of e-banking services coincides with the Financial Crisis of 2008, prompting concerns that our findings may be influenced by shifts during the 2008 crisis. We explore alternative explanations, primarily focusing on regulatory changes and liquidity injections from the Federal Reserve. Our findings show that these factors are insufficient in explaining the divergence observed in the banking sector.

Related Literature

Our paper contributes to several strands of literature. First, our paper contributes to our understanding of monetary policy transmission through the banking sector. The literature highlights several channels through which monetary policy passes through banks: the bank lending channel (e.g., Bernanke and Blinder, 1988; Kashyap and Stein, 1994), bank capital channel (e.g., Bolton and Freixas, 2000; Van den Heuvel et al., 2002), and deposit market power channel (e.g., Drechsler, Savov and Schnabl, 2017). Traditional studies on monetary policy transmission often focus on the aggregate quantity of deposits, treating the banking sector as a homogenous entity. This perspective suggests that rising interest rates lead to a net outflow of deposits and a reduction in overall bank lending. Our findings shed light on a more nuanced dynamic within the banking sector. We delve beyond aggregate measures to examine how changes in interest rates influence deposit flows across different types of banks—specifically, between low rate and high rate banks. We demonstrate that these two types of banks not only diverge in their liability management but also in their asset portfolios. When interest rates rise, deposits migrate from low rate banks to high rate banks, resulting in increased lending to personal and C&I loans, which are increasingly held by high rate banks. Thus, tracking aggregate deposit flows from the banking sector misses a substantial amount of flows within the banking sector. Understanding this heterogeneity in deposit rates is important for understanding the banking sector's capacity for maturity transformation, liquidity provision, and credit extension.

While recent research has highlighted the distinct behavior of FinTech banks in response to monetary policy, existing research presents contrasting views. Koont, Santos and Zingales (2023) suggest digital banks, identified by having mobile applications with more than 300 reviews, experience deposit outflows despite competitive rates due to "flighty" clientele. In contrast, Erel et al. (2023) examine a sample of purely online banks and find that these banks tend to offer higher rate and attract more deposits as interest rates rise. Our findings align more closely with those of Erel et al. (2023), though our focus is on a sample of very large banks, thereby complementing and extending their insights. We also observe significant changes among low rate banks, which have begun to offer less sensitive deposit rates and hold safer, longer-term securities. The substantial migration of deposits away from low rate and systematically important banks during rate hikes underscores potential fragility in the banking sector, as discussed in recent studies by Haddad, Hartman-Glaser and Muir (2023) and Drechsler et al. (2023). Last, we focus on the asset side of banks' balance sheets, in addition to the liabilities side, presenting evidence on how monetary policy is transmitted across different types of assets.

Broadly, we explore how digital disruption affects the banking sector. Previous research, such as Buchak et al. (2018), has highlighted how regulatory arbitrage has contributed to the rapid expansion of shadow banks. Our study illustrates the profound effects of technology within the banking sector itself. Jiang, Yu and Zhang (2022) show that digital disruption drives branch closures, leading to the emergence of two distinct types of banks. Some banks continue to rely on physical branches and can charge higher rents on both deposits and loans, while others operate remotely, offering services at lower rents. This study highlights the significant implications of these changes for financial inclusion. Relatedly, Haendler (2022) show that small community banks are slow to adopt mobile banking, losing both deposits and small business lending, while Koont (2023) demonstrate that mid-sized banks, after adopting mobile banking, grow faster and attract more uninsured deposits. Our paper complements theirs by providing evidence of how these digital disruptions lead to heterogeneous asset and liability management strategies across banks and draw implications on monetary policy transmission and the capacity of the banking sector to engage in maturity transformation and to provide loans to households and businesses.

Our study focus on how deposit distribution patterns vary within the banking sector, with an emphasis on financial and macroeconomic implications. While there is an extensive body of literature examining the distribution of deposit rates within banks and across branch networks (e.g., Radecki, 1998; Heitfield, 1999; Biehl, 2002; Heitfield and Prager, 2004, Park and Pennacchi, 2008; Granja and Paixao, 2021), there is less work that examines the distribution of deposit rates across banks. Recent work by Iyer, Kundu and Paltalidis (2023) investigates variations in deposit rates across banks within a region, arguing that these rates reflect the gradual build-up of liquidity shortages. Building on this perspective, our study reveals that the banking landscape now exhibits more heterogeneity in deposit rates. We find that within the 25 largest banks, deposits shift substantially towards high rate banks when interest rates rise. This complements d'Avernas et al. (2023) which provides evidence of variation in deposit-pricing behavior of large and small banks. At the aggregate level, Hanson et al. (2024) show that banks are increasingly resembling bond funds that invest in long-term securities. Our findings indicate that this trend is predominantly observed among low rate banks. Furthermore, it is important to emphasize that high rate banks should not be confused with money market funds, which also tend to experience inflows when interest rates rise (Xiao, 2020). In fact, it is the high rate banks that engage in lending activities. Thus, we argue that tracking aggregate deposit flows from the banking sector misses a substantial amount of flows within the banking sector. Understanding this heterogeneity in deposit rates is important for understanding the banking sector's capacity for maturity transformation, liquidity provision, and credit extension.

Lastly, our paper contributes to our understanding of banks' evolving business models. Benmelech, Yang and Zator (2023) show that low branch density banks attract more flighty depositors, and hence face a higher run risk during the 2022 banking crisis. We show that the alignment of more rate-sensitive borrowers with high rate banks and less rate-sensitive borrowers with low rate banks leads to distinct asset management approaches for these banks. Specifically, we show that when interest rates rise, high rate banks assume greater credit risk while low rate banks assume more maturity risk. This finding is consistent with Drechsler, Savov and Schnabl (2021); Supera (2021) who propose that banks with high franchise value, i.e., low rate banks, invest in long-term assets to align the duration of their assets and liabilities, effectively hedging against interest rate risk. Beyond maturity matching, we highlight the connection between franchise value and banks' risk-taking behaviors.

2 Motivating Fact: Divergence in Deposit Rates

We document a salient pattern in banking over the past decade: the increasing dispersion of deposit rates. Prior to the 2008 financial crisis, deposit rates were relatively similar across large banks – the standard deviation of deposit rates was low. However, the subsequent period has witnessed a significant shift. Today, deposit rates follow a bimodal distribution, with two distinct peaks and an economically large spread in deposit rates.

Figure 1 illustrates the dispersion of bank deposit rates for the 25 largest banks at the peak of three rate cycles. We measure deposit rates in two ways: the 12-month certificate of deposit ("CD rate") – the most widely offered deposit product from the RateWatch database – and the interest expense rate on deposits ("DepRate"), calculated using data from the Call Report. Later analysis considers additional measures. In 2007Q3, deposit rates exhibited a unimodal distribution, with similar mean and median values, and low standard deviation.[4] However, subsequent rate cycles (2019Q1 and 2023Q1) show a shift towards bimodality with diverging mean and median values. The divergence is quantitatively very large: from 2007Q3 to 2023Q1, the standard deviation of the CD rate tripled from 0.63 to 1.94.

While the distributions show a clear divergence in deposit rates across banks, a potential concern is whether the variation in rates represents a systematic shift or is influenced by a few relatively smaller banks offering very high rates. We study the share of bank assets corresponding to different measures of CD rates relative to the sample median: below 0.75 times the median, between 0.75 and 1.25 times the median, and above 1.25 times the median. Figure 2 illustrates a significant shift in the distribution of banks' asset shares. Before the 2008 financial crisis, 84% of bank assets were associated with rates offered near the median. By 2023Q3, the situation had drastically shifted: 45% of assets were connected to rates offered below 0.75 times the median, and 48% corresponded to rates exceeding 1.25 times the median. [5]

In Section 4, we will show that the divergence in deposit rates is accompanied by significant shifts in the business models of two distinct types of banks, specifically regarding branch operations, lending behavior, and asset allocation. Following this, Section 5 explores the impact of this diverging banking sector on the transmission of monetary policy and the distribution of risk in the banking sector. Finally, in Section 6, we introduce a simple theoretical framework to understand the economic forces that give rise to this divergent banking landscape.

[4] In 2007Q3, the average Federal Fund rate was 5.18%. Among the top 25 banks, the average CD rate was 4.08%, with a corresponding median of 4.06%; and the average DepRate was 3.29%, with a corresponding median of 3.21%.

[5] The above patterns are demonstrated through an analysis of the 25 largest banks by asset size, collectively representing approximately 70% of the sector's total assets (see Appendix Figure D.1). In the appendices, Appendix Figure D.2 and Appendix Figure D.3 provide further evidence that the divergent trends in deposit rate settings persist across the entire banking spectrum over an extended sample period.

3 Data and Methodology

In this section, we first describe the data and methodology used in our analysis. Our sample spans 2001Q1 through 2023Q3. Our sample period covers three rate hiking cycles: 2004Q1-2009Q1, 2015Q2-2020Q2, and 2021Q4-2023Q3.

3.1 Data

Bank data. We collect quarterly data on bank balance sheets and income statements from the Reports of Condition and Income (Call Reports) from 2001Q1 to 2023Q3. We aggregate to the bank holding company level using BHC ID as the common identifier. We supplement this with data from the FDIC Statistics on Depository Institutions (SDI). SDI data provides comprehensive financial and operational information on all FDIC-insured institutions on a quarterly basis. The details of the variables are listed in Table C.1.

Deposit rates. We source weekly surveyed deposit rate data from the RateWatch database, provided by S&P Global, covering the period from January 2001 to March 2023.[6] We primarily focus on the 12-month certificate of deposit accounts with a minimum of $10,000, due to its comprehensive reporting coverage and its capacity to promptly reflect banks' overall rate-setting choices.[7] To eliminate potential biases from misreporting, we first calculate the average CD rate for each branch. We then aggregate this at the bank-quarter level by averaging across the various branches within each bank holding company (BHC).[8]

Branch data. We use branch-level bank deposit information from the FDIC. The FDIC administers an annual survey that encompasses all FDIC-insured institutions. The survey, known as the *Summary of Deposits* (SOD), compiles data on a branch's deposits and the corresponding parent bank information as of each June 30th.

Demographics data. To understand the demographic characteristics of bank customers, we use the US Census county-level data and data from the FDIC Survey of Consumer Use of Banking and Financial Services. Specifically, we use US Census data to compute the average customer age for each bank by weighting the average age in a county based on the number of branches in each county every quarter. We also use household survey data from the FDIC Survey of Consumer Use of Banking and Financial Services to examine the characteristics of households that use bank tellers versus e-banking. The survey is conducted biannually from 2009, and we use data from the 2013, 2015, 2017, and 2019 waves.

[6] While this data is collated weekly, it is important to highlight that banks contribute this information on a voluntary basis.

[7] The 12MCD10K is the most common deposit product reported in RateWatch. As shown in Panel B of Table C.2, there is a strong correlation of 0.92 between this CD rate and the average deposit rate paid by banks, as calculated from the Call Reports data. We further show that the CD rates are also strongly correlated with other deposit products such as $25,000 money market deposit accounts (MM) and savings accounts (SAV). The correlation between the CD and MM rates is 0.844, while the correlation between the CD and SAV rates is 0.686.

[8] Appendix Table C.3 indicates that deposit rates are primarily determined at the BHC level. BHC fixed effects alone explain as much of the variation in deposit rates as bank-level fixed effects.

3.2 Methodology

The goal of our analysis is to document the emergence of two distinct types of banks within the industry. We start by classifying banks based on the deposit rates they offer and proceed to examine how other characteristics, such as branch service provision, asset allocation, and the risk profile of loan portfolios, have evolved over time for these two categories of banks. It is important to note that our analysis does not imply that the deposit rates offered by banks directly dictate their other operational decisions. Deposit rates, number of branches, and lending decisions are each endogenous decisions made by banks. Rather, we propose that two divergent business models have developed alongside the rise of e-banking, with each type of bank adopting a business model that is reflected across various aspects of their operations. We use deposit rates as the primary basis for classification because they are frequently updated and well-measured empirically, offering a readily observable and timely metric for distinguishing banks. For simplicity, we categorize them as "high rate" and "low rate" banks.

The empirical strategy employed resembles a difference-in-differences (DiD) design. Figure 2 shows the emergence of two distinct bank types, distinguished by deposit rates, starting from 2009, which we use as our cut-off point. Our baseline empirical specification is the following:

$$Y_{i,q} = \delta_q + \beta \cdot \mathbb{1}_{\text{High rate},i} \times \text{Post}_q + \cdot \mathbb{1}_{\text{High rate},i} + \text{Controls}_{i,q-1} + \varepsilon_{i,q}. \tag{1}$$

where i and q indicate the bank and quarter-year, respectively, $\mathbb{1}_{\text{High rate}_i}$ denotes whether bank i is a high rate bank, $Post_t$ denotes the post-2009 period. We include two control variables, the return on assets and the Tier 1 capital ratio from the previous quarter. Moreover, we weight each observation by the asset size from the preceding quarter, ensuring that the estimated effect reflects the designated bank type. We use Driscoll-Kraay standard errors, clustering at the quarterly frequency to account for heteroskedasticity, cross-sectional dependence, and we use a lag length of 4 quarters to account for autocorrelation.

The β coefficient quantifies the divergence in $Y_{i,q}$ between high and low rate banks post-2009 relative to the pre-2009 era. Importantly, β by itself does not pinpoint which type of bank primarily drives this divergence, as both are expected to adapt their strategies over time. To illustrate these strategic differences more clearly, we employ time-series plots that aggregate the balance sheets of banks within each category, thus providing a visual representation of the distinct adjustments each type of bank has made.

3.3 Classification of High and Low Rate Banks

We follow a two-stage process to classify banks based on their deposit rate behavior. In the first stage, we identify the 25 largest banks each quarter based on their total assets as of the previous quarter.[9] We then rank banks quarterly based on both the CD and DepRate rates. This multi-source approach mitigates noise and limitations inherent in each individual measure. While DepRate offers a direct and comprehensive measure of deposit rates paid by

[9]Appendix Figure D.1 presents the market share of the top 25 and top 100 banks over time. Panel B of Table 2 demonstrates that the distributions of CD and DepRate rates are comparable across the analyzed periods.

banks, it may be slow to adjust. Conversely, the CD rate provides more immediate insight into banks' pricing strategies but is limited to a specific product category and may be susceptible to missing data due to potential self-reporting issues. To incorporate rate information from both sources, we employ a weighted rank method. We first calculate a one-year rolling average of the CD rate and the DepRate for each bank. We then rank banks using each rate separately. Due to missing observations in the CD rate, we standardize based on the number of observations each quarter, to ensure standardized ranks fall within the same range (0 to 1). We then take an average of the CD rate and DepRate rankings. Lastly, we rerank the banks based on their average deposit rate to produce a combined ranking.[10]

We classify banks using their combined rate rank, taking into account the skewed distribution observed in Figure 1, which shows a smaller number of high rate banks relative to low rate banks. To capture this asymmetry, we define banks ranked in the top quintile as high rate banks and the rest as low rate banks. Moreover, to prevent frequent classification changes due to short-term variations, we apply a stability criterion: banks identified as high rate in over 90% of the analyzed quarters retain this classification throughout the sample period. This ensures consistent bank categorization and avoids misinterpretation based on temporary fluctuations. Detailed classifications for a select group of banks are provided in Appendix Table C.5.

4 Diverging Banking Sector

Panel A of Table 2 compares key characteristics of high rate and low rate banks across two periods: 2001-2008 and 2017-2023.[11] Before 2009, high rate banks typically operated fewer branches and held assets with longer maturities compared to low rate banks. However, after 2009, the gap between the two bank types in these aspects widened further. high rate banks also exhibited significantly higher net interest margins (NIMs) and charge-off rates post-2009. Notably, the share of insured deposits remained relatively stable for both types of banks throughout the sample period.

We now dig in to each of these statistics in more detail.

4.1 Diverging Deposit Rates

We validate our classification over time by analyzing the rate behavior of high and low rate banks in Figure 3. Figure 3a presents the time series of average deposit rates for each of the two groups. We find that the high and low rate banks exhibited remarkably similar deposit rates through the monetary policy cycle before 2009, featuring a relatively consistent and narrow rate differential between the two groups. Importantly, Figure 3b reveals no significant difference in sensitivity to the Federal Funds Rate ("Federal funds rate") during this period, suggesting both groups respond similarly to interest rate changes. However, a dramatic shift

[10]For illustration, consider the case with three banks: A, B, and C where A offers the highest rate and C offers the lowest rate. B does not report their CD rate. Consequently, based on DepRate alone, their standardized ranking would be is 1/3 (A), 2/3 (B), and 3/3 (C). Based on the CD rate (available for A and C only), the standardized ranking is 1/2 (A) and 2/2 (C), respectively. We take an average of the two rankings and produce an average ranking of 5/12 (A), 2/3 (B), and 3/3 (C). Finally, we rerank them based on the averages: 1 (A), 2 (B), 3 (C).

[11]A similar analysis for the 2009-2016 period is presented in Appendix Table C.2.

occurs starting with the second rate hiking episode of our sample period from 2015Q2. During this period, high rate banks actively raise rates in response to rising interest rates, while low rate banks remain largely stagnant. This leads to considerable disparity between the two groups. Figure 3c further illustrates this shift for a select subset of individual banks. Notably, under the new banking regime, JP Morgan Chase, Wells Fargo, US Bancorp, and Bank of America maintain their position as low rate banks, while Citi, Marcus by Goldman Sachs, and Capital One are positioned among the high rate banks. We show that these findings are robust to an expanded set of the 100 largest banks in Appendix Figure E.1.

The marked divergence in rate-setting behaviors between high rate and low rate banks raises a critical question: What factors influence a bank's decision to adopt a high rate or low rate strategy? In Appendix Table C.4, we investigate how characteristics of the top 100 banks prior to 2009 influenced their classification as high rate or low rate banks post-2009. Our analysis indicates that banks characterized by a higher ratio of branches to deposits, a smaller number of branches, a larger share of insured deposits, and operations in demographically younger counties during the earlier part of our sample period are more likely to become high rate banks after 2009.

4.2 Diverging Branches

The divergence in branching strategies between high rate and low rate banks continues to widen in the post-2009 period, with high rate banks further reducing their reliance on physical branches while low rate banks maintain a more extensive branch presence.

We start by documenting the dispersion of the branch-to-deposits ratio over the peaks of three rate cycles in 2007Q3, 2019Q1, and 2022Q2, see Figure 4.[12] A higher branch-to-deposits ratio indicates that a bank has more branches relative to its deposit size, suggesting a broader physical presence and possibly higher operating costs. Conversely, a lower ratio implies a lesser reliance on physical branches to raise deposits. Similar to Figure 1, we see a widening gap in branch utilization across banks over time. The dispersion of the branch-to-deposits ratio across three rate cycles has significantly increased, implying that banks are increasingly divergent in their branch strategies.[13]

We then directly examine differences in banks' branching strategies. Figure 5 compares the branches operated by high and low rate banks. We draw two observations from this figure. First, from the beginning of our sample, high rate banks consistently maintain a lower number of branches compared to low rate banks. Second, while the number of branches remains relatively stable for low rate banks over the entire period, high rate banks experience over 63% decline in the number of branches in the post-2009 era (note that the figure is on a

[12]To ensure that the results are not influenced by banks primarily engaged in businesses other than retail deposits, we limit our analysis to banks with more than 15 branches (the sample average is 1,214). This restriction excludes Charles Schwab, J.P. Morgan & Co (before 2000), State Street, Merrill Lynch, Morgan Stanley, Bank of New York Mellon, Goldman Sachs, Ally Financial, and ING. The first seven of these banks focus on broker or investment banking, while the latter two are newer FinTech banks. For a broader view, Appendix Figure D.4 includes density plots without these exclusions. Further, we show that our findings are robust to an expanded sample of all banks over an extended time horizon from 1994Q4 in Appendix Figure D.4.

[13]We note that we pick these three dates for ease of comparison to the rest of our analysis but that the divergence is branches is a lower frequency trend not directly connected to the monetary policy cycle.

log scale).[14] To address concerns that branch closures by high rate banks might be driven by deposit withdrawals, we additionally analyze the logged ratio of branches to the real value of deposits (deposits normalized by the consumer price index). Figure 5b shows that while the branch deposit ratio has fallen for both low rate and high rate banks, it has fallen at a much steeper rate for high rate banks.

These observations align with the findings of Jiang, Yu and Zhang (2022): low rate banks prioritize maintaining branch networks, while high rate banks are increasingly focusing on providing primarily e-banking services. For instance, high rate banks like Ally and Marcus have a limited number of branches, whereas major low rate banks such as JP Morgan, Bank of America, and Wells Fargo maintain a relatively stable number of branches. However, it is worth noting that all 25 banks in our sample offer e-banking services including mobile and online banking. The reliance of banks' business models on physical branches is the key determinant of this change. Consistent with this interpretation, column 1 of Table 7 shows that banks' IT spending, including both data processing expenses and telecommunications expenses, also exhibits a diverging pattern between high rate and low rate banks after 2009.

Moreover, e-banks appear to cater to distinct customer demographics. We find that high rate banks tend to locate their much smaller number of branches in demographically younger counties. Figure 5c shows the time series of the average age of populations in areas with high rate and low rate bank branches, indicating a diverging trend after 2009. Prior to 2009, both bank types operated branches in areas with similar average population ages. However, high rate banks are increasingly concentrating their branches in regions with an average population roughly two years younger than those served by low rate banks. We further analyze the target clientele of branch-based banks and mobile banks in Appendix Figure B.1 using FDIC Survey of Consumer Use of Banking and Financial Services. We find that physical branches tend to attract a clientele that is older, less educated, and has a lower income compared to mobile banking users.[15]

While the figures illustrate clear time-series trends, they cannot definitively establish the statistical significance of the divergence or rule out systemic changes within the banking sector. To address these limitations, we employ a regression analysis based on Equation (1) and present the results in Table 3. Consistent with the trends observed above, we find that high rate banks report about a 65% additional reduction in the number of branches, about a 37% additional decline in the branch deposit ratio, and a 0.6-year additional decline in the average age after 2009, in comparison to low rate banks.[16] These magnitudes are stable even

[14] We estimate the percentage changes from the log-level estimates using: $e^{-\beta} - 1$. A logarithmic change of -1 implies $e^{-1} - 1 = -0.63$.

[15] The findings are consistent with the distinctions between tech-savvy and non-tech-savvy consumers as documented by Jiang, Yu and Zhang (2022). Between 2012 and 2018, the average age of households using physical branches increases by 2.77 years (4.92%), while the average age of households using mobile banks increases by 1.46 years (3.65%) over the same period. The average income of households using physical branches also increases by \$5.29K (11.63%), compared to \$9.96K (17.23%) for households using e-banking over the same time period. In terms of education, 50% of households using physical branches have a college degree, compared to over 75% of households using e-banking.

[16] We compute these changes in columns (1)-(4) using: $e^{-\beta} - 1$. In columns 5-6, we estimate the coefficient as a percent of the mean of the dependent variable.

after accounting for aggregate shocks through quarter fixed effects, as indicated in the even numbered columns. [17]

Given our finding that the number of branches for low rate banks has remained unchanged since 2010, it may seem puzzling that these banks now charge customers more (offering lower deposit rates) compared to the pre-2010 period. We highlight two potential explanations. One possibility is that the operational costs for high rate banks have risen, in part because they now provide both traditional in-person banking services through branches and also provide e-banking services (recall that we are focused on the top 25 banks, all of which offer e-banking). Another plausible explanation is that low rate banks may implement higher markups in their deposit businesses. This could stem from several factors, including the reduction in branch networks due to closures by high rate banks, or the increased reliance of their customer base on branches as less branch-reliant customers migrate toward banks offering more appealing interest rates. To assess the dominant explanation, we examine the non-interest expense as a ratio of asset between the two types of banks in column 2 of Table 7 to assess whether low rate banks exhibit higher operating costs compared to high rate banks. Our findings indicate that low rate banks do not exhibit higher non-interest expenses, contradicting the marginal cost-based hypothesis. In the next section, we examine the differences on the asset side of banks' balance sheets, providing evidence in support of the market power explanation.

4.3 Divergence on the the Asset Side

Figure 6 provides an overview of asset composition within high and low rate banks. We immediately note several patterns. Low rate banks hold far more securities and far less personal and C&I loans. For example, these banks hold 55% in treasury securities, mortgage backed securities (MBS), and real estate, with a moderate increase over the sample period. In contrast, personal lending and C&I loans comprise only 25% of their assets, while 20% are in uncategorized securities or loans. High rate banks, on the other hand, hold fewer long-maturity securities, with only 35% of assets in treasuries, MBS, and real estate lending as of 2023. However, their proportion of personal and C&I lending has risen to about 44% by 2023. Combined, this paints a picture that low rate banks tend to hold longer duration assets, much of it in the form of securities such as MBS. High rate banks tend to do more traditional lending to firms and households albeit at shorter durations. We will delve deeper into these trends to examine how the asset mix compares to these banks' liability structures – for example, because low rate banks have near "fixed rate" liabilities, they are better able to hold long duration fixed-rate assets.

We start by studying banks' net interest margins. We first show that high rate banks have a slightly higher net interest margin, despite offering higher deposit rates. Since net interest margin is the difference between interest earned (for example, on loans), and interest paid (for

[17] As before, we demonstrate robustness in an expanded sample with the 100 largest banks in Appendix Figure E.2 and Appendix Table E.1. Moreover, we show, in Appendix Table D.1, that this divergence is driven both by changes within individual banks, such as branch closures, and by compositional shifts, illustrated by the rapid growth of high rate banks propelling them into the largest bank category by asset size.

example, on deposits), this immediately indicates that high rate banks earn higher rates on their assets. We show this comes from credit risk in the form of riskier lending. In contrast, we show high rate banks have less duration on the asset side and thus engage in less maturity transformation. These findings are in line with the broad patterns shown in Figure 6.

4.3.1 Net Interest Margin

Figure 7 compares the changes in interest expense, interest income and NIM for high rate and low rate banks throughout our sample. Figure 7a exhibits a consistent difference in interest expense, with high rate banks incurring significantly higher costs throughout the sample period. This gap widens during the recent two rate hike cycles.[18] Similarly, Figure 7b demonstrates that prior to 2009, high and low rate banks generate comparable levels of interest income. However, a significant divergence emerges after 2009. Consequently, the NIM which represents the difference between interest income and interest expense, does not decline for high rate banks. In contrast, Figure 7c reveals a diverging pattern in NIM between the two banks, with high rate banks maintaining a roughly 75 basis-point advantage. We show that these findings are robust in an expanded sample of the largest 100 banks in Appendix Figure E.3. These patterns suggest that high rate banks tilt their portfolio towards higher-yielding assets. Column 3 of Table 7 reveals no significant difference in non-interest income between high rate and low rate banks, countering an alternative hypothesis that differences in deposit rates might be offset by differences in fee income.

There are two primary strategies through which banks can achieve higher interest income: taking on more credit risk or investing in longer-maturity assets to capture the term premium. We find all of the effect on interest income comes from credit risk, while maturity goes in the opposite direction. The following sections delve into how high rate and low rate banks differentially manage their credit risk and maturity risk exposures.

4.3.2 Credit Risk

A bank's assets typically comprise of securities and loans. However, credit risk is primarily associated with loan portfolios, as securities like Treasuries and MBS often benefit from government backing. Therefore, we focus on loan portfolios to analyze the risk-taking behavior of the two bank types.

Consistent with the observed pattern in interest income, our analysis reveals a similar divergence in loan rates across banks in Figure 8a. Both low rate and high rate banks report similar loan rates, ranging between 6% and 8% before 2009. Following this period, the lending rate of high rate banks remains stable, while those of low rate banks decreases to a range of 4% to 6% as overall interest rates decline. By the end of our sample, high rate banks charge loan rates of 10% compared to 6% for low rate banks. This divergence pattern is further supported

[18] The divergence in interest expense is not as pronounced as compared to the rate gap in Figure 3. This is because, in addition to the interest paid on deposits, interest expense also encompasses wholesale funding costs, as well as interest paid on bonds or other debt securities. This provides a more complete picture of the overall cost of funds for a bank, as it captures borrowings from various sources, not just customer deposits. As interest accrues over time and payments are spread out, the pattern of interest expenses tends to change more gradually compared to the CD rate. Therefore, the resulting divergence in patterns is less pronounced.

by the results in column 1 of Panel A in Table 4, as per the regression model specified in Equation 1.

To calculate the credit spread in loans, we subtract the equivalent maturity Treasury yield from the loan rate. This isolates the portion of the loan rate that reflects the borrower's creditworthiness, or credit risk premium. Figure 8b illustrates the evolution of credit spreads over time for two types of banks. Analogous to loan rates, we observe a significant divergence in credit spreads after 2009, exceeding 200 basis points by the end of the sample. Column 2 of Panel A in Table 4 reinforces this observation, showing a 1.2% increase in credit spreads for high rate banks compared to low rate banks after 2009. This increase is economically significant, being 35% higher than the sample average credit spread of 3.4%. This implies that high rate banks predominantly generate a spread from riskier lending activities, as opposed to capturing a term premium.

We provide direct evidence that high rate banks assume higher credit risk by looking at proxies for default risk. Elevated default risk leads to portfolio losses, which are reflected in the charge-off rate – the percentage of loans or credit accounts that the bank deems as noncollectable and removes from its books as losses. The charge-off rate is an indicator of the credit quality of the bank's portfolio and reflects the proportion of loans that the banks expects will not be repaid by borrowers. Figure 8c compares the charge-off rate for high rate and low rate banks. Consistent with the previous findings, we observe that the charge-off rate for high rate banks is typically higher than for low rate banks. Towards the end of the sample period, high rate banks report a charge-off rate that is more than double that of low rate banks. We observe a similar magnitude in column 3 of Panel A in Table 4. This finding provides additional evidence supporting our hypothesis that high rate banks amplify their exposure to credit risk compared to low rate banks.

Panel B of Table 4 breaks down charge-off rates to elucidate where high rate banks predominantly assume credit risk. We observe that post-2009, high rate banks exhibit significantly higher credit risk, with charge-off rates in real estate and C&I loans both 0.2% higher, and in personal loans 0.6% higher, compared to low rate banks. These increases are economically significant; for instance, a 0.2% increase in the charge-off rate for C&I loans represents a 35% rise above the sample average. These findings suggest that high rate banks take greater credit risk in pursuit of higher yields.

Moreover, the heightened credit risk assumed by high rate banks suggests that wholesale funding providers might perceive them as riskier borrowers. This perception can manifest in both higher costs and potentially lower utilization of wholesale funding for these banks. Our analysis demonstrates that high rate banks pay significantly higher rates for wholesale funding and utilize a smaller proportion of it compared to low rate banks after 2009, as illustrated in Appendix Figure B.3. We demonstrate that these differences are statistically significant in columns (7) and (8) of Table 7. Overall, our findings are consistent with the market perception that high rate banks may be riskier.

4.3.3 Maturity Transformation

Next, we investigate whether the observed divergence in deposit rates affects their maturity exposures. High rate banks, aiming to boost asset yields, may invest in longer-maturity assets. However, this strategy could expose them to significant interest rate risk due to potential maturity mismatches within their balance sheets. Banks often employ duration matching to mitigate interest rate risk by aligning the average maturities of their assets and liabilities (Drechsler, Savov and Schnabl, 2021). Figure 9 compares the maturity profiles of high rate and low rate banks, encompassing both securities and loans to assess potential differences in their exposure to maturity risk.

Figure 9a shows the average maturity in years of assets held by high rate banks and low rate banks. In the pre-crisis period, the average maturity of assets in low rate banks is around 6 years, which is 50% longer than the 4-year maturity reported by high rate banks. After 2009, the average maturity of assets in low rate banks gradually increases to almost 8 years, representing a 33% increase. In contrast, the average maturity of assets held in high rate banks remains around 4 years. Thus, by the end of our sample in 2023, the average maturity of assets held in low rate banks is twice as large as that in high rate banks. Similarly, we compare the share of short-term assets – the proportion of a bank's assets that mature within one year – and find that high rate banks report a higher share of short-term assets than low rate banks in Figure 9b. While the share of short-term assets for high rate banks hovers around 55% across the whole sample period, the share of short-term assets for low rate banks declines from 50% in the pre-crisis period to 35-40% by the end of our sample in 2023.

Panel A of Table 5 examines the significance of the divergence in asset maturities between two types of banks. Prior to 2009, high rate banks typically held assets with maturities that were, on average, 1.8 years shorter and comprised a 6.1% larger share of short-term assets compared to low rate banks. Post-2009, the analysis reveals that high rate banks continued to maintain loans and securities with significantly shorter maturities – approximately 0.7 years less on average (about 12% lower than the sample average) – and a 3.0% higher proportion of short-term assets than low rate banks. These findings demonstrate that low rate banks tend to hold assets with longer maturities relative to their high rate counterparts.

Banks can adjust their asset maturity profile in two ways: by altering the composition of different asset classes within their portfolios and by investing in longer-maturity assets within each class. We first examine how the composition of asset classes has changed over time focusing on a subset of assets for which maturity information is available: treasury securities, MBS, real estate loans, and other loans.[19] MBS exhibit the longest maturity, exceeding 15 years, followed by real estate loans with a maturity of around 10 years, treasuries with a 5-year maturity, and other loans with an average maturity of approximately 2 years, see Appendix Figure B.2b.

Panel B of Table 5 demonstrates that, post-2009, the proportion of other loans – which have the shortest maturities – decreased by an additional 4.4% in low rate banks compared to high rate banks. Other asset classes did not exhibit significant divergence during the same period. Furthermore, changes within specific asset categories are evident in Panel C of the table.

[19] Other loans include credit card loans, automobile loans, commercial and industrial loans, home equity loans, loans to financial firms, real estate adjustable loans, and revolving credit, and etc.

Specifically, Columns 3 and 4 indicate that after 2009, high rate banks held MBS and treasuries with considerably shorter maturities – 0.9 years shorter for MBS and 1.8 years shorter for treasuries – highlighting a strategic shift towards assets with reduced duration. These significant shifts in portfolio composition towards shorter-maturity assets, coupled with reduced maturities within security assets, contribute to the lower average maturity observed in high rate banks, as discussed earlier.

4.3.4 Decomposition of Maturity and Credit Risks

In this section, we take a closer look at the portfolio holdings of high rate banks and low rate banks to examine how their strategies differ in managing maturity risk and credit risk. We classify loans into four categories: personal loans, commercial and industrial (C&I) loans, real estate loans, and other loans, and we divide securities into two categories: MBS and other securities.[20]

Table 6 examines how each share shifts for high rate and low rate banks. Compared to low rate banks, high rate banks have notably increased their allocations to personal loans by approximately 7.5%, C&I loans by about 3.1%, and other loans by around 3.2% since 2009. In contrast, they have decreased their holdings in real estate loans and MBS by roughly 12.5% and 3.1%, respectively, during the same period. Given that personal and C&I loans carry higher credit risk than MBS, which are backed by the U.S. government, these shifts indicate that high rate banks are taking on significantly more credit risk by reallocating their assets towards higher-risk loan types. Simultaneously, they are reducing their exposure to interest rate risk by decreasing their holdings in long-maturity assets like real estate loans.

Collectively, our findings suggest contrasting risk-taking behavior between low rate and high rate banks – low rate banks opt for safe, long-term investments while high rate banks shift towards risky but short-term investments. This is consistent with our key conjecture that low rate banks, benefiting from a large spread from depositors, choose a safer asset portfolio to minimize default risk. These banks also hedge their franchise value against fluctuations by investing in long maturity assets. Deposits at low rate banks resemble fixed rate debt, as deposit rates don't fluctuate with market interest rates. Holding fixed rate securities (e.g., long-maturity Treasuries and MBS) makes sense from a risk-management perspective. Conversely, high rate banks, which operate with a narrower margin from depositors remain cautious of interest rate risk. As a result, high rate banks favor investments with higher credit risk but shorter maturities. They match the maturity of their assets and liabilities, which are effectively "floating rate." However, high rate banks earn a spread by taking on additional credit risk. In Section 6, we will draft a simple model to further illustrates the institution and mechanism.

4.4 Alternative Explanations

Our evidence supports the idea that the growing divergence within the banking sector is connected to the advent of e-banking services. However, the timing of the divergence coincides

[20] As depicted in Figure 6, treasury securities comprised less than 1% of the portfolio before 2009. We group them with other securities, which include U.S. government, agency, and sponsored agency obligations, as well as securities issued by states and political subdivisions, among others.

with the onset of the Great Financial Crisis of 2008. This section explores alternative GFC-related explanations that might account for the observed divergence.

Regulatory Changes Following the financial crisis, the implementation of Basel III and the Dodd-Frank Act marked a significant shift towards stricter capital requirements and more robust liquidity provisions, aiming to enhance the resilience of the banking sector, particularly among large banks. Specifically, Basel III mandated a 3% Tier 1 supplementary leverage ratio for large BHCs with assets exceeding $250 billion. Similarly, the Dodd-Frank Act subjected all BHCs with more than $50 billion in assets to Enhanced Prudential Regulation (EPR). Despite all top 25 banks in our sample surpassing the $50 billion threshold, only about one-third possess assets over $250 billion. This regulatory disparity could influence the divergent business models within the banking sector. To examine this hypothesis, we investigate the differences in Tier 1/2 ratios between the two bank types before and after 2009.[21] Columns (2)-(4) in Table 7 present results. The lack of significant differences across the three columns suggests that the regulatory shifts post-financial crisis may not be the primary catalyst for the sector's divergence.[22]

Liquidity Injection from the Federal Reserve After the financial crisis of 2008, the Federal Reserve launched a series of quantitative easing (QE) programs, designed in part to bolster liquidity within the banking system. Initially, these QE programs focused on purchasing US government-backed securities. As illustrated in Figure B.2a, low rate banks exhibit a marginally higher proportion of MBS and Treasuries. In 2008, for instance, low rate banks hold 15.5% of their portfolios in Treasuries and MBS, compared to 12% for high rate banks. Diamond, Jiang and Ma (2023) argues that the infusion of reserves by crowding out lending activities due to balance sheet constraints. It is possible that this could contribute to some of the observed divergence within the banking sector.

To explore this hypothesis, we compare the volume of reserves for high rate and low rate banks, as reserve levels are significantly influenced by QE operations (see e.g., Acharya et al., 2023). We analyze the data presented in Column 5 of Table 7 and the temporal trends in Appendix Figure B.5. The coefficient on the interaction between the high rate indicator and post-2009 indicator coefficient is insignificant. This suggests that the observed divergences in the banking sector are unlikely to be explained by the differential impact of QE on reserve levels between high and low rate banks.

Advances in Screening Technology Chang, Cheng and Hong (2023) demonstrate that banks with superior screening technology attract more uninsured deposits and take on riskier loans. As the returns from risky projects increase, these banks garner more uninsured deposits, predominantly from entrepreneurs engaged in risky projects. This mechanism could potentially

[21] Note that supplementary leverage ratio data became available starting Q2 2016

[22] Appendix Figure B.4 plots how the Tier 1 and Tier 2 ratios evolve over time for the two types of banks. Right after the financial crisis, there was a increase in the Tier 1 ratio, which was mainly driven by the $33 billion equity injection to Citibank. At the same time, Citibank redeemed $24.2 billion of subordinated notes, which lowered the Tier 2 ratio, see 10-K file.

explain some aspects of the diverging patterns observed, such as risk-taking behaviors and deposit flows, particularly if high rate banks have become more specialized in screening technology over the years. However, this theory would also predict diverging patterns in the share of uninsured deposits between two types of banks. We test this hypothesis in column 6 of Table 7. The results, however, reveal no significant differences between the two types of banks after 2009. Furthermore, our findings on diverging charge-off rates suggest that even advanced screening technology at high rate banks cannot completely mitigate the credit risks they are exposed to. Therefore, the divergence in screening technology may not fully account for the patterns we have documented.

5 Macroeconomic Effects

The overall financial landscape is transforming as banks adopt increasingly divergent strategies. This evolution could alter the traditional channels for the transmission of monetary policy and alter the distribution of risks within the banking sector. This section studies the broader macroeconomic implications of a divergent banking system.

5.1 Transmission of Monetary Policy

This section delves into the differential responses of two types of banks to the transmission of monetary policy, assessing its effects on both prices and quantities. Changes in monetary policy can be considered shocks to banks' balance sheets and funding, offering additional confirmation of the divergence within the banking sector as documented in the previous section.

5.1.1 Rate Sensitivity to Federal Funds Rate Changes

We initiate our analysis by exploring how deposit rates of both high rate and low rate banks respond to adjustments in the Federal Funds rate across three rate-hiking cycles within our dataset. Specifically, we calculate the "deposit rate sensitivity," which represents the ratio of the cumulative change in deposit rates, starting from the first quarter of each rate-hiking cycle, to the respective change in the Federal Funds Target rate.

Figure 10 illustrates the deposit rate sensitivity across the three rate-hiking cycles for CD rate, savings deposit rate, and DepRate. We find that low rate and high rate banks have similar deposit rate sensitivity during the first rate hiking cycle of 2004Q1 to 2008Q2.[23] While the average deposit rate sensitivity remains relatively stable between 2015Q4 and 2020Q1, and between 2021Q4 and 2023Q3, a significant divergence emerges between low rate and high rate banks. In these recent cycles, low rate banks barely adjust their deposit rates in response to Federal Funds rate hikes, resulting in deposit rate sensitivity close to zero. Conversely, high rate banks exhibit a marked increase in their deposit rates, reflected in strongly positive deposit rate sensitivity.

[23] Between the 2004Q1 and 2008Q2, the savings deposit rate showed minimal sensitivity to changes in the Federal Funds rate, whereas the CD rate demonstrated considerable responsiveness. Interestingly, despite these differences in responsiveness, both bank types displayed similar deposit rate sensitivity for both products.

We test these relationships through the following regression framework:

$$
\begin{aligned}
\Delta Y_{i,q} = {} & \alpha + \beta_1 \times \Delta \text{Fed Funds}_q \times \mathbb{1}_{\text{High rate},i} \times \text{Post}_q + \beta_2 \times \Delta \text{Fed Funds}_q \times \mathbb{1}_{\text{High rate},i} \\
& + \beta_3 \times \Delta \text{Fed Funds}_q \times \text{Post}_q + \beta_4 \times \Delta \text{Fed Funds}_q + \beta_5 \times \mathbb{1}_{\text{High rate},i} \\
& + \beta_6 \times \mathbb{1}_{\text{High rate},i} \times \text{Post}_q + \text{Controls}_{i,q-1} + \varepsilon_{i,q}
\end{aligned} \tag{2}
$$

where ΔFed Funds$_q$ denotes the quarterly change in the Federal Funds Target Rate and $\Delta Y_{i,q}$ denotes the quarterly change in deposit rates.

The first three columns of Table 8 reveal a striking divergence in deposit rate sensitivity between two types of banks subsequent to 2009. Taking CD rates as an example, we observe that post-2009, the average deposit rate sensitivity for banks offering higher rates stands at 0.623, in stark contrast to a mere 0.144 for banks with lower rates.[24] This indicates that a 1 percentage point increment in the Federal Funds rate correlates with an additional 0.479 percentage point uptick in deposit rates for high rate banks in the period after 2009. Conversely, prior to 2009, the deposit rate sensitivities were 0.599 for low rate banks and 0.533 for high rate banks, respectively. Hence, the divergence pattern primarily stems from low rate banks reducing their deposit rate sensitivity, while high rate banks only slightly increase theirs. We see similar patterns for SavRate sensitivity and interest expense rate sensitivity. [25]

The greater interest expense rates sensitivity of high rate banks does not necessarily indicate they bear higher interest rate risk. As illustrated in column 4, high rate banks also benefit from comparatively higher interest income rates during periods of rising rates post-2009. Consequently, the sensitivity of the net interest margin (NIM) depicted in column 5 does not demonstrate a notable difference between the two types of banks This observation aligns with our analysis in Section 4.3, where we demonstrate that high rate banks tend to hold more short-term, floating-rate assets, suggesting a nuanced understanding of interest rate risk management in these institutions.

For robustness, we control for common macroeconomic factors using quarter fixed effects, confirming that the observed differences in betas between high and low rate banks are indeed driven by post-2009 changes (Appendix Table C.6). Additionally, we expand our sample to include the largest 100 banks in Appendix Table E.4.

5.1.2 Deposits Reallocation During Monetary Policy Cycles

The divergence in deposit rate sensitivities across the two types of banks significantly influences the reallocation of deposits during monetary policy cycles.

Figure 12 compares the deposit growth for high rate and low rate banks over the past three rate hiking cycles. We find that high rate and low rate banks exhibit similar deposit

[24] The computation of the average rate sensitivity for high rate banks is derived from the sum of 0.545 - 0.066 + 0.599 - 0.455, whereas for low rate banks, it is calculated from 0.599 - 0.455.

[25] While similar to deposit rate sensitivity in direction, interest expense betas (column 3) are slightly lower due to timing mismatches with deposit contracts. Interest expense typically lags the change in the Federal funds rate, as banks may have contracts with their depositors that lock in interest rates for a certain period of time. Columns 1 and 2 avoid this issue by using the current deposit rates offered from RateWatch. Column 3 computes the interest expense using Call Reports data which will reflect the lag. See Appendix Table C.1 for details.

growth in the first rate hiking cycle between 2004Q1 and 2007Q4. However, in the last two rate hiking cycles, high rate banks exhibit significantly higher deposit growth than low rate banks, suggesting that there is substantial reallocation of deposits when interest rates rise. This makes sense: as interest rates rise, the deposit spread between high and low rate banks widens, and deposits flow towards high rate banks. During the rate hiking period from the 2015Q3 to 2019Q4, high rate banks observed a cumulative deposit growth exceeding that of their low rate counterparts by more than two-thirds. The same trend is observed in the most recent rate hiking cycle, from 2021Q4 to 2023Q3, where low rate banks experienced negative deposit growth, while high rate banks remained almost unaffected. This observation demonstrates the significant influence of monetary policy on the allocation of deposits across high rate and and low rate banks.

We assess the extent of deposit reallocation using Specification (2). Given the potential for slow-moving deposit flows, we investigate the relationship between annual deposit growth and annual changes in the Federal Funds rate, distinguishing between two types of banks before and after 2009. The first two columns of Table 9 corroborate that high rate banks attract more deposits during periods of interest rate hikes. Specifically, after 2009, a one percentage point rise in the Federal funds rate is associated with an increase of 2.87 to 3.25 percentage points in annual deposit growth for high rate banks.

Robustness We address potential concerns that our findings may be influenced by banks switching categories, merger and acquisition (M&A) activity, or limitations within our sample. Initially, to mitigate concerns regarding category switching and M&A activity, we fix the set of top 25 banks at the start of each rate-hiking period and exclude observations with quarterly deposit growth exceeding 10% (about 4% of observations).[26] Appendix Figure D.6 demonstrates that our findings remain robust. Secondly, to further validate the robustness of our findings, we extend our analysis to include the largest 100 banks, covering a broader period from 1993Q1 as shown in Appendix Figure E.6. This expansion confirms that the observed patterns persist well beyond the specific sample initially used in the main analysis, underscoring the generalizability of our results across a larger set of institutions and a longer timeframe.

5.1.3 Monetary Policy Transmission to Lending

Given the divergence in asset holdings between the two types of banks post-2009, the reallocation of deposits has implications for the transmission of monetary policy across various asset categories.

We investigate the growth trajectories of personal loans, C&I loans, real estate loans, and MBS throughout monetary policy cycles. Specifically, we regress annual growth rates for each of these categories on annual changes in the Federal Funds Rate, along with interactions for high rate banks and an interaction for the post period.

[26]During this period, two significant deposit growth events were due to M&As: Wells Fargo's acquisition of Wachovia on October 3, 2008, and PNC's acquisition of National City Bank on October 24, 2008, as detailed in Appendix Figure D.7.

The findings, as detailed in Table 9, demonstrate that post-2009, the sensitivity of personal and C&I lending growth to interest rate changes is significantly *positive* for high rate banks, while the growth of MBS shows a significantly *negative* sensitivity. Specifically, a one percentage point increase in the Federal Funds rate results in high rate banks extending an additional 1.2% in personal loans (column 3) and 1.7% in C&I loans (column 5). Conversely, low rate banks reduce their MBS holdings by 4.9% (column 9).[27] Real estate loans do not exhibit distinct sensitivities to the Federal Funds rate between the two types of banks after 2009. The robustness of these results is reinforced after controlling for quarter fixed effects, which mitigates potential aggregate demand-side shocks (refer to columns 4, 6, 10).

The findings alter the conventional understanding that an increase in the Federal Funds rate typically leads to a contraction in bank lending. Our evidence suggests that increases in interest rates affect the distribution of deposits, shifting them substantially towards high rate banks relative to low rate banks. This shift is reflected in credit provision. Specifically, while the rise in the Federal Funds rate prompts low rate banks to curtail their holdings in securities, it encourages high rate banks to extend more credit to consumers and small businesses.

This analysis also serves as stronger evidence supporting the distinct asset allocation strategies between two types of banks. In line with our findings documented in Tables 4 and 5, the results demonstrate that high rate banks take on considerable credit risk in personal and C&I loans compared to low rate banks, which prefer safer, longer-maturity assets such as MBS. Generally, the larger deposit growth in high rate banks, triggered by an increase in rates, translates into significant growth in personal and C&I lending sectors where high rate banks are more actively involved. These findings are robust in an expanded sample with the 100 largest banks, as illustrated in Appendix Table E.5.

An immediate potential concern with these findings is whether the observed increases in lending are driven by heightened demand from households or firms, rather than an expanded loan supply from high rate banks experiencing significant deposit growth. Table 10 shows that, if anything, lending rates associated with these categories fall in response to an increase in the Federal funds rates, consistent with the supply hypothesis. In contrast, if consumer and firm demand were driving these increases, one would expect to see lending rates rise rather than fall. While not definitive, this evidence strongly suggests the interpretation that higher Federal Funds rates prompt high rate banks to expand credit provision in personal and C&I loans, while significantly reducing low rate banks' credit provision to MBS.

Another concern is that our classification of banks might merely reflect the distribution of time and savings deposits across banks. Supera (2021) argue that banks use time deposits, which grow during rate hikes, to finance business lending. If high rate banks predominantly hold time deposits, and low rate banks primarily hold more liquid deposits like savings and demand deposits, then our observations might align with Supera (2021). To examine this alternative hypothesis, we extend his Figure 1 to 2023Q3 in Figure B.7 and found that while C&I

[27] The computation of the effect size is derived from columns 3, 5, 7, and 9 of Table 9, where quarter fixed effects are excluded. Specifically, the effect size for high rate banks post-2009 is calculated by aggregating four coefficients involving the term ΔFFar_y. The effect size for low rate banks involves summing the coefficients of ΔFFar_y and $\Delta\text{FFar}_y \times Post$. For instance, in the context of personal loans, the effect size for high rate banks is calculated as 1.188% = 4.636% - 3.468% - 0.799% + 0.819%, and for low rate banks, it is 0.02% = -0.799% + 0.819%.

moved with time deposits before 2010, this correlation dissolves post-2009. Our findings could potentially rationalize this new fact: time deposits of low rate banks no longer offer market rates, while savings deposits of high rate banks start to match market interest rates. Consistently, our analysis, which includes controls for various deposit types as shown in Table C.7, yields robust results. This suggest that our results are not driven by time deposits or the split between time, savings, or demand deposits. Collectively, our new evidence shows that recognizing heterogeneous banks, rather than only heterogeneous deposit types, is essential to understanding these dynamics.

5.2 Aggregate Implications

Explaining the Absence of a Large Credit Crunch for Recent Rate Hikes The current rate hiking cycle saw a sharp increase in interest rates beginning in early 2022 from roughly 0% to around 5.3%. Concurrently, aggregate deposit growth declined substantially as shown in Panel A of Figure 13.[28] The annual decline in aggregate deposit growth of 8-10% is the largest deposit outflow in percentage terms since the H8 data series began in 1973 (the FRED database) and was accompanied by disruptions in the banking sector with the failure of several high profile banks. According to the deposits channel of monetary policy, such a dramatic decrease in deposits would usually indicate a large credit crunch, leading to a significant contraction in credit availability (Drechsler, Savov and Schnabl, 2017). However, as we have shown, this aggregate deposit outflow masks substantial heterogeneity across banks – with the majority of the outflows concentrated in low rate banks (recall Figure 12c). Further, we've shown that high and low rate banks exhibit distinct lending behaviors and asset profiles. In particular, low rate banks focus substantially on Treasuries, MBS, and real estate lending relative to high rate banks. Panel B of Figure 13 shows that the aggregate outflow of deposits, which again is significantly concentrated in low rate banks, coincides almost perfectly with a large drop in holdings of Treasuries and agency MBS. In contrast, we've shown that high rate banks focus lending relatively more on consumer loans. Panel C of Figure 13 shows that the growth rate in consumer loans does not track aggregate deposits — in fact the correlation appears to be negative, if anything, with consumer loan growth remaining near average levels in recent quarters.[29]

This highlights why taking into account the heterogeneity in banks is important to understanding aggregate effects and in understanding in which dimensions we may see a credit contraction. Since monetary policy has disproportionately large effects on low rate banks, we should expect asset categories that low rate banks focus on (primarily MBS, Treasuries, and real estate loans) to experience relatively larger contractions compared to those that high rate banks focus on (consumer loans, and to a lesser extent C&I loans). These patterns appear consistent with the aggregate data, though we do not argue this evidence is definitive.[30] Thus, our

[28]We use total deposits DPSACBM027SBOG less large time deposits LTDACBM027NBOG.

[29]We use the series USGSEC for Treasury and agency securities, and the series CONSUMER for consumer loans.

[30]An alternative explanation for the observed dynamics could be that as the economy recovers, the demand for loans increases, prompting banks to extend more consumer and C&I loans. To support this expansion, banks might liquidate a significant portion of their treasury and agency securities holdings. However, this strategy is economically viable only if the yield from loans exceeds that from treasuries or agency securities to a greater

analysis demonstrates the importance of considering deposit distribution across bank types for a more nuanced understanding of the deposit and lending channels of monetary policy transmission.

Aggregate Banking Sector Capacity for Maturity Transformation and Risk-Taking Given the distinct portfolio compositions of the two bank types, the banking sector's ability to undertake maturity transformation and originate higher-risk loans is significantly influenced by the distribution of deposits between these banks. If deposits continue to flow towards high rate banks – whether due to prolonged periods of tight monetary policy or tech-savvy depositors favoring these banks – the sector as a whole is less likely to engage in maturity transformation and increasingly assume greater credit risk. According to our estimates, if 10% of deposits shifts from low rate banks to high rate banks, the banking sector as a whole originates, approximately, 5% shorter-maturity loans and assumes 20% higher credit risk.[31] Such a shift could potentially increase the concentration of credit risk within the banking sector while limiting its ability to provide long-term financing for infrastructure and mortgages.

Implications for Regulators Our findings indicate that diverging banks face distinct risk profiles: low rate banks are more susceptible to interest rate risk, while high rate banks are more susceptible to credit risk. Though both risks can precipitate bank runs, their dynamics differ significantly. As shown in Jiang et al. (2023), interest rate risk becomes particularly salient during Federal Fund rate hikes, typically occurring in stronger economic conditions, whereas credit risk escalates during economic downturns, prompting potential Federal Fund rate reductions. As discussed earlier in Section 4.4, the existing regulatory capital requirements may not fully account for the differential risks within the banking sector. The uniformity in capital ratios, despite varying risk exposures, suggests that current regulatory practices may overlook potential vulnerabilities with important implications for systemic risk evaluation and the formulation of macroprudential policies and monetary interventions.

6 Endogenous Emergence of a Diverging Banking Sector: A Simple Framework

In the end, we offer a simple framework to rationalize the divergence observed in the banking sector. Our static model is based on the frameworks established by Salop (1979), Allen

extent than in the period prior to the increase in the Federal funds rate. According to the Fred Economic database, the average spread between the rate on new 60-month auto loans (RIFLPBCIANM60NM) and the 5-year treasury yield (DGS5) stood at 4.26% during 2020-2021 but fell to 3.08% during 2022-2023. This decrease implies that the marginal benefit of liquidating agency securities for lending has diminished. Consequently, this explanation may not adequately account for the behavior observed in the banking sector.

[31] As of the fourth quarter of 2022, the weighted average maturities for high and low rate banks were 4.50 and 7.47 years, respectively. If high rate banks experience an additional 10% inflow of deposits from low rate banks, the average maturity of loans originated in the banking sector would decrease by 0.30 years, representing a reduction of 5%, benchmarked to the average maturity of 6.42 years. Similarly, the credit spreads for high and low rate banks are 3.97% and 1.15%, respectively, as of the fourth quarter of 2022. With a similar 10% inflow of deposits from low to high rate banks, the average credit spread would increase by 0.28%, representing a 20% increase from the average of 1.39%.

and Gale (2004). A key aspect of our model is the integration of endogenous adoption of e-banking by banks, facilitated by technological advancements, as in Jiang, Yu and Zhang (2022). We have intentionally simplified the model to include only essential components, which allows for a focused analysis of the economic dynamics involved.

6.1 Without e-Banking Services

The economy has two banks, labeled A and B, which compete for depositors and extend loans to risky projects. We assume that before the advent of e-banking services, the existence of physical branches were important in attracting depositors.

Depositors Depositors are uniformly distributed around the circle, whose circumference is normalized to be one. Let $s \in [0, 1)$ be the location of a depositor. Every depositor has one dollar and faces a decision regarding the choice of bank for their deposit. The depositors' utility is influenced by two primary factors: the deposit rates offered by the banks and the proximity of the bank to their location:

$$U_i(j) = r_j + \eta(1/2 - d_{i,j})\mathbb{1}(\text{Branch}_j) \quad \forall j \in \{A, B\},$$

where r_j is the deposit rate offered by bank j, $d_{i,j}$ represents the distance from depositor i to bank j, and η presents utility derived from branch services. Depositor i chooses bank A if $U_i(A) > U_i(B)$.

Banks Banks A and B choose to situate their branches on a circular layout. To streamline our analysis, we restrict each bank to establishing just one branch, with cost per branch (κ), which includes costs like office rental fees, payable upfront.[32] By operating a local branch, banks set the deposit rate r_j to attract depositors and also decide on the risk level associated with their loan portfolios, represented by a return L_j. Banks can generate value from both deposit-taking and extending loans (Egan, Lewellen and Sunderam, 2022).

Following Allen and Gale (2004), we model the return on a risky loan portfolio using a two-point distribution: it yields a return of $L_j = f + l_j$ with probability $p(l_j)$, and a default return of zero with a probability with a probability $1 - p(l_j)$. Here, f signifies the Federal Funds rate, while l_j represents the risk premium. For simplicity, we assume $p(l_j) = \alpha - l_j$ for $l_j \in [0, \alpha]$, so that riskier lending has a higher default probability.

Banks' maximize the following profit function:

$$\max_{l_j, r_j} \ p(l_j)(f + l_j - r_j)D_j - \kappa\mathbb{1}(\text{Branch}_j), \tag{3}$$

where D_j is the amount of depositors choosing bank j. Banks encounter two trade-offs. First, offering a higher deposit rate attracts more deposits from competitors, but results in a reduced

[32] To simplify the analysis, we assume an upfront marginal cost per branch. If this cost were assumed to be paid ex-post, it would link it to the banks' survival probabilities, thereby complicating the analysis, especially in scenarios involving asymmetric cases and the presence of e-banking. Furthermore, we believe that the upfront cost assumption accurately reflects the fixed costs associated with branch maintenance per period.

deposit spread. Second, while taking more risk yields a greater risk premium, it also elevates the bank's exposure to the risk of default.[33]

Results Given the symmetry of the two banks, they position their branches equidistantly around a circle. The unique solution is characterized as follows, with the proof detailed in Appendix A:

$$r_A = r_B = r^* = f + \alpha - \eta, \quad l_A = l_B = l^* = \alpha - \frac{\eta}{2}.$$

Depositors' preference for the geographical proximity of bank branches enables banks to impose a markup of $\frac{\eta}{2}$ on their deposit services. Importantly, equilibrium risk raking l^* inversely correlates with η. Banks take less risk as the deposit markup charged increases. The rationale behind this is that the markup earned on the banks' liabilities side is an almost guaranteed return. When such a return is high, banks are less inclined to pursue risky projects that expose them to default risk.

It is important to contrast our mechanism regarding risk-taking behaviors with the perspective on outstanding debt as argued by Jensen and Meckling (1976). The key difference lies in the role of bank deposits in our scenario, which generate value for banks. When this value creation is substantial, it limits the banks' incentives to take risks, thereby moderating potential risk-taking. Conversely, when value creation from liabilities is minor, the effects described in Jensen and Meckling (1976) come into play, encouraging banks to take risks in an effort to expropriate wealth from depositors.

The markup also helps cover the costs associated with operating branches, resulting in the equilibrium profits for Bank A and Bank B being equal to

$$Prof_A = Prof_B = \frac{\eta^2}{8} - \kappa.$$

We assume that $\frac{\eta^2}{8} - \kappa \geq 0$ ensuring that the equilibrium scenario involves both banks operating branches.

In summary, before the emergence of e-banking, banks are homogeneous, providing similar deposit rates below the Federal funds rate and exhibiting similar levels of risk-taking.

6.2 With e-Banking Services

The advent of e-banking services revolutionized banking by allowing banks to cater to depositors without being limited by geographical boundaries. Following Jiang, Yu and Zhang (2022), we assume depositors gain utility, represented as γ, from the convenience of e-banking services offered:[34]

$$V_i(j) = r_j + \eta(1/2 - d_{i,j})\mathbb{1}(\text{Branch}_j) + \gamma\mathbb{1}(\text{E-Banking}_j) \quad \forall j \in \{A, B\}.$$

[33]We assume that deposits are insured by the FDIC, thereby providing depositors with a consistent incentive to deposit their capital.

[34]For example, Lu, Song and Zeng (2024) demonstrates that depositors value fast-payment technology and tend to transfer their deposits from slower banks to faster banks.

As banking services are not solely reliant on physical branches, banks are presented with three strategic choices: maintaining existing branches, adopting e-banking services only, or combining both. The banks' objective function is revised to reflect this modification:

$$\max_{l_j, r_j, b_j, e_j} p(l_j)\left(f + l_j - r_j\right)D_j - \kappa \mathbb{1}(b_j) \tag{4}$$

where b_j = Branch if bank j decides to keep branches open, and e_j = E-Banking if bank j offers e-banking services. Under this set-up, we solve the banks' optimal strategies, as outlined in Theorem 6.1 and proof in Appendix A.

Theorem 6.1. *After e-banking service is available, two potential market structures can emerge:*

- *When the cost of branch (κ) is relatively large, a diverging banking sector emerges. {A: Branch + E-Banking, B: E-Banking only} and its symmetric case are Nash equilibria. In this case, $r_B - r_A = \frac{\eta}{5}$ and $l_B - l_A = \frac{\eta}{10}$.*
- *When the cost of branch (κ) is relatively small, no diverging pattern emerges. Both banks offer a combination of branch services and e-banking services.*

The above results show that when operating branches is relatively costly, a diverging banking sector endogenously emerges in the e-banking era. One type of banks offer *both branch and e-banking services*, whereas the other only offer *e-banking exclusively*. The specialized business models affect how banks manage their liabilities and assets. Local branches provide a competitive advantage in attracting customers concerned about geographical proximity, allowing banks with branches to offer lower deposit rates. This ensures a substantial rent for these banks, prompting them to minimize default risk by selecting loan portfolios that are comparatively safer, albeit yielding lower returns. Conversely, e-banking-only banks need to provide higher deposit rates to attract depositors, leading to a narrow deposit spread. Consequently, they opt for riskier loan portfolios that promise higher returns to maximize profits.

Robustness of Model Our results remain robust when we model banks' lending opportunities following the framework proposed by Boyd and De Nicolo (2005), where banks set lending rates and borrowers (entrepreneurs) determine the riskiness of their projects. In this framework, high rate banks need to set higher lending rates to cover their deposit expenses. In response, borrowers optimally choose riskier projects. Moreover, our results are robust when we model the quality of branch service, η, as a decision variable for each bank. Here, a higher η incurs higher costs but results in better branch quality, which attracts more depositors.

Model Limitations Given that our model is static, it does not offer predictions regarding maturity transformation. Nonetheless, drawing on the arguments made by Drechsler, Savov and Schnabl (2021) that banks hedge against the stable franchise value of branches by investing in longer maturity assets, we can infer that banks that maintain branches are likely to invest in assets with longer maturity. Conversely, banks primarily focused on e-banking invest assets with shorter maturity. Moreover, our model does not consider the dynamic market structure within the banking sector. Jiang, Yu and Zhang (2022) show that digital disruption leads to an influx of new, e-banking-centric banks, intensifying competition within that segment. Concurrently, incumbent banks with branches may gain market power as competitors close their branches. In such a scenario, the dispersion in deposit rates and risk-taking between branch-dependent banks and e-banking-focused banks is likely to be accentuated.

7 Conclusion

We document the emergence of two distinct types of banks in the last decade: high rate banks, which align their deposit rates with market interest rates, and low rate banks, whose deposit rates are less responsive to market interest rates. Despite the aggregate deposit rate sensitivity of the banking sector showing minimal change, there is now a clear bimodal distribution in deposit rates.

We show that high rate banks have a limited physical branch presence, maintain short-term assets, and primarily earn a spread by taking on credit risk. Conversely, low rate banks primarily engage in maturity transformation. They hold longer-duration, interest rate-sensitive assets but assume less credit risk. When interest rates rise, deposits shift significantly from low rate banks toward high rate banks. As a result, low rate banks sell off MBS, whereas high rate banks even extend more credits to personal loans and C&I loans. Therefore, understanding the distribution of deposits across high and low rate banks is important for a comprehensive understanding of the deposit and lending channels of monetary policy, beyond tracking total deposits in the banking sector.

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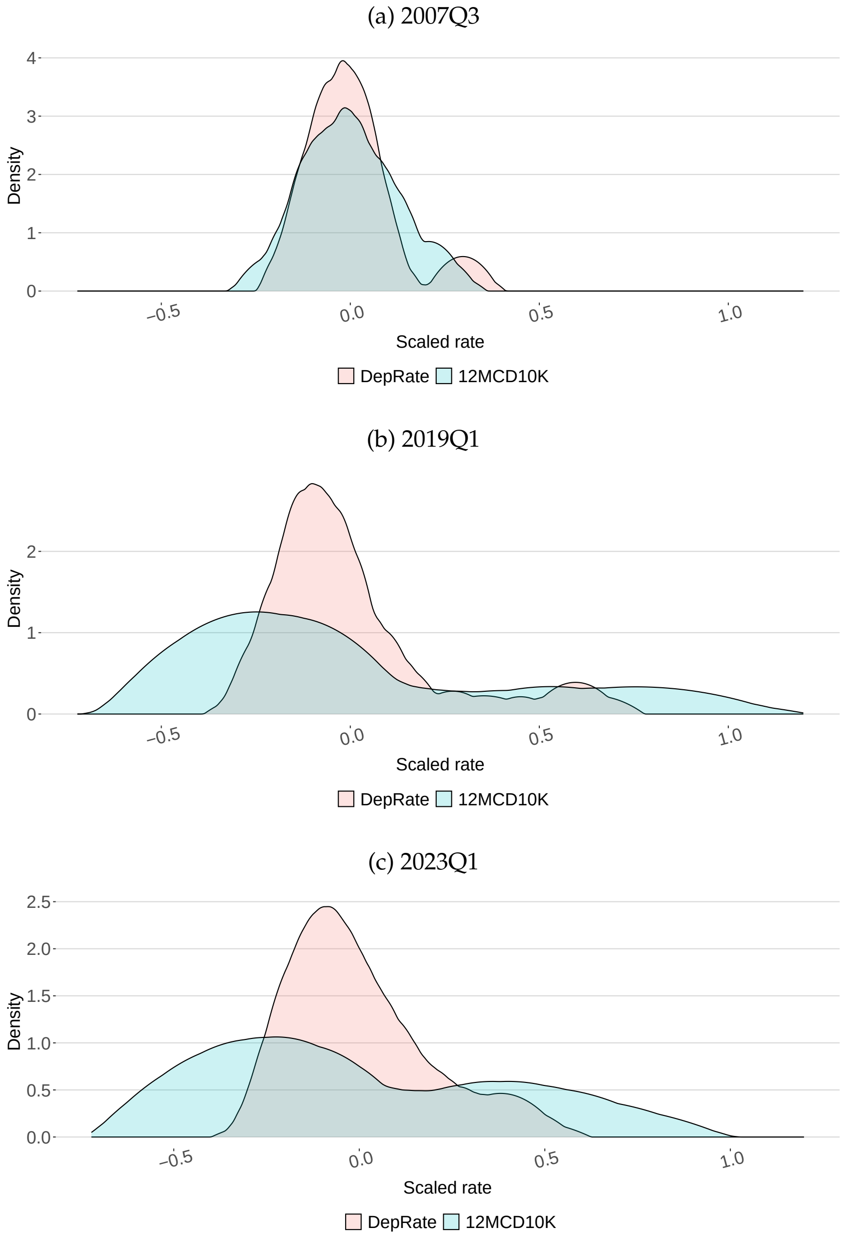
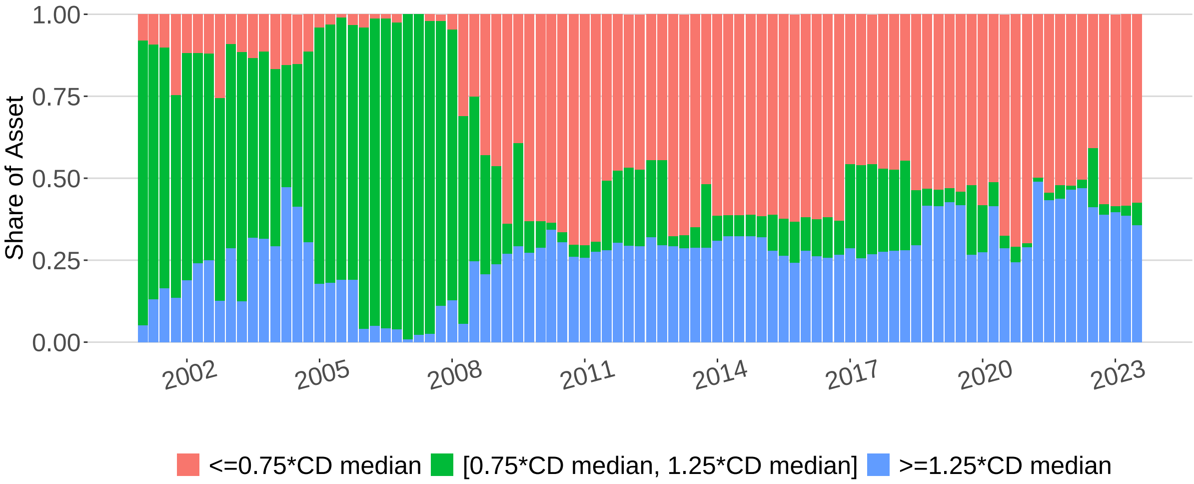
Figure 1: Dispersion of Deposit Rates for Top 25 Banks



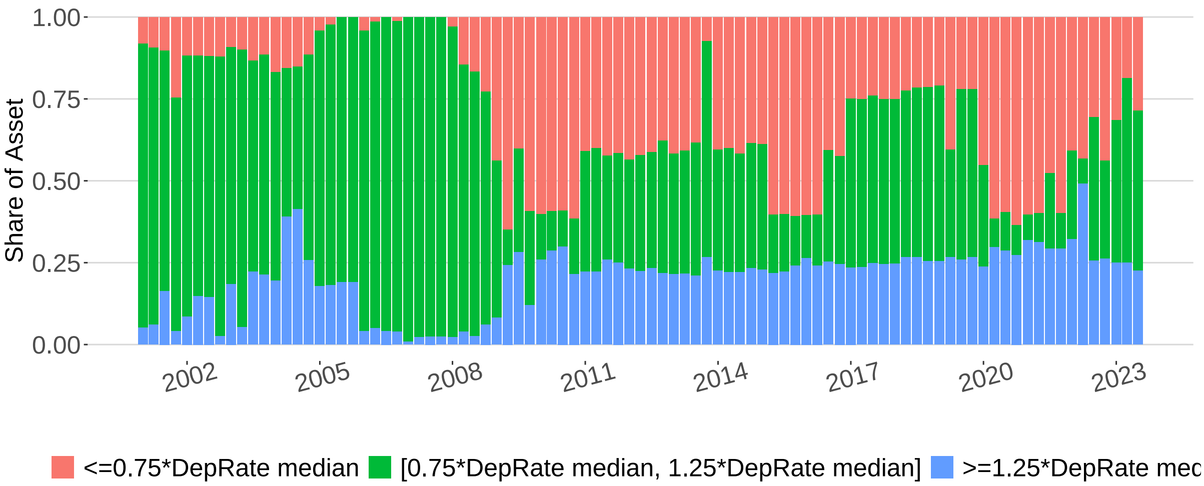
Notes: This figure presents kernel density plots of the scaled and demeaned 12-month certificate of deposit rates of at least $10,000 (12MCD10K) and the scaled and demeaned deposit rates (DepRate) calculated from Call Reports offered by the top 25 banks at the peak of each rate hiking cycle. Figures a, b, c present the kernel density in 2007Q3, 2019Q1, and 2023Q1, respectively. The scaled and demeaned 12MCD10K rates (DepRate) are calculated by first scaling the 12MCD10K rates (DepRate) by the Market Yield on U.S. Treasury Securities at 1-Year Constant Maturity (DGS1 series in FRED) and then demeaning the scaled rates. The top 25 banks are defined according to bank size in the beginning of each quarter.

Figure 2: Asset Distribution of Top 25 Banks

(a) Classification based on 12MCD10K



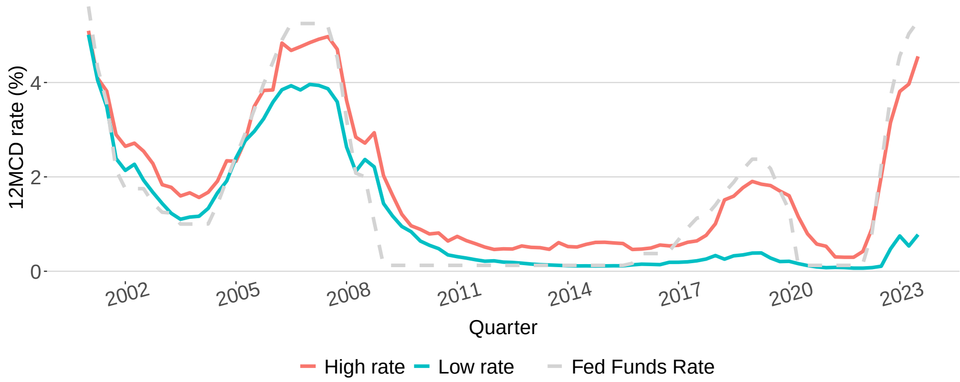
(b) Classification based on DepRate



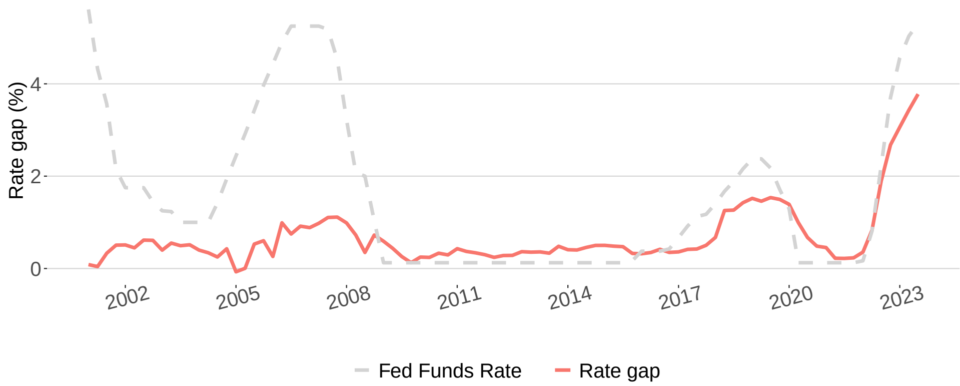
Notes: This figure illustrates the distribution of bank assets among three categories for the top 25 banks: banks with deposit rates below 0.75 times the sample median, banks with deposit rates within the range of 0.75 times to 1.25 times the sample median, and banks with deposit rates exceeding 1.25 times the sample median. Panel a and b present asset distribution classified based on 12-month certificate of deposit rates of at least $10,000 (12MCD10K) and deposit rates (DepRate) calculated from Call Reports. If the 12MCD10K bank rate is unavailable, the classification is determined based on DepRate in Panel a. The top 25 banks are defined according to bank size in the beginning of each quarter.

Figure 3: Dispersion of Bank Deposit Rates

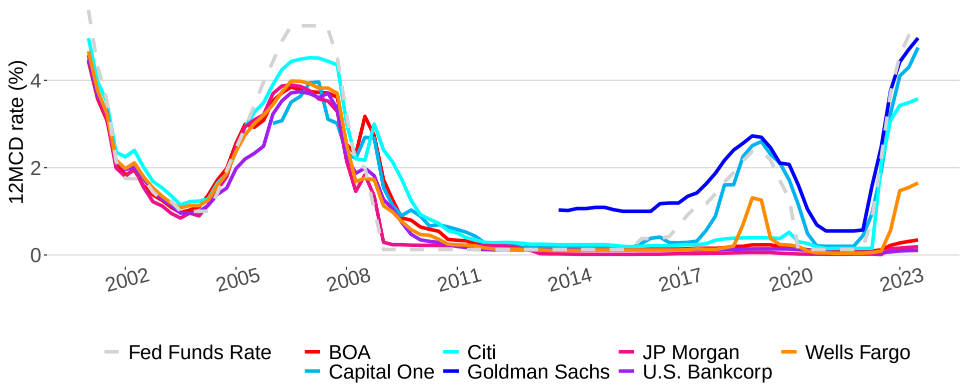
(a) Rate



(b) Rate Gap



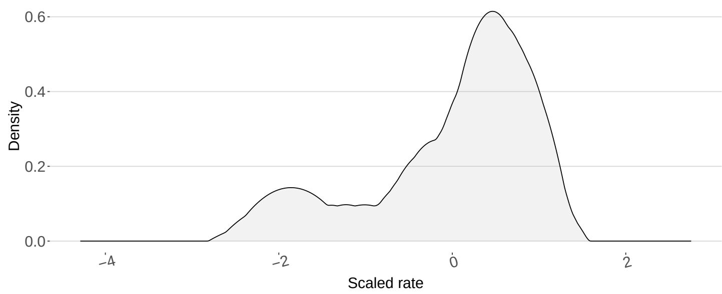
(c) Rate by Bank for Select Banks



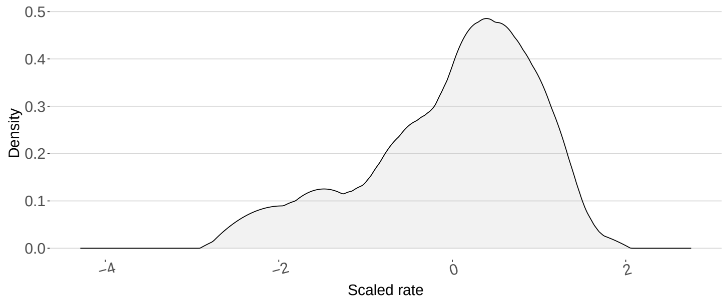
Notes: This figure characterizes the dispersion of deposit rates of high and low rate banks from 2001Q1 through 2023Q3 among the top 25 banks. We construct the time-series for each bank type by taking an average of the banks' 12MCD10K rates, weighted by assets. Figure 3a presents a time-series plot of average 12MCD10K for *high rate* (blue) and *low rate* (red) banks. Figure 3b presents the gap in the 12MCD10K rates between high rate and low rate banks. Figure 3c presents the 12MCD10K rate by bank. A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MCD10K rate and deposit rate from the Call Report, falls within the top quintile.

Figure 4: Dispersion of Branch/Deposits ratio for Top 25 Banks

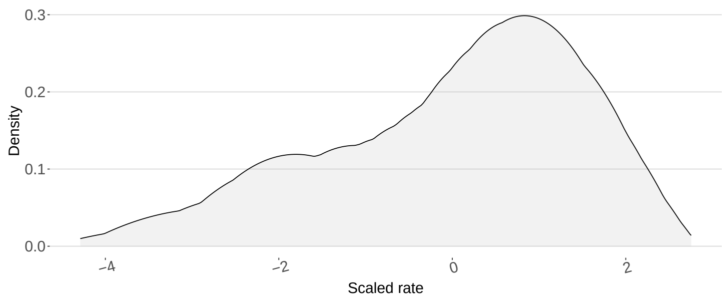
(a) 2007Q3



(b) 2019Q1



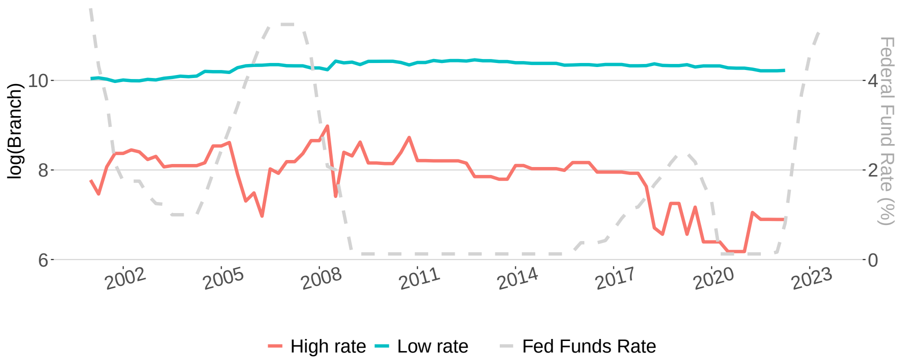
(c) 2022Q2



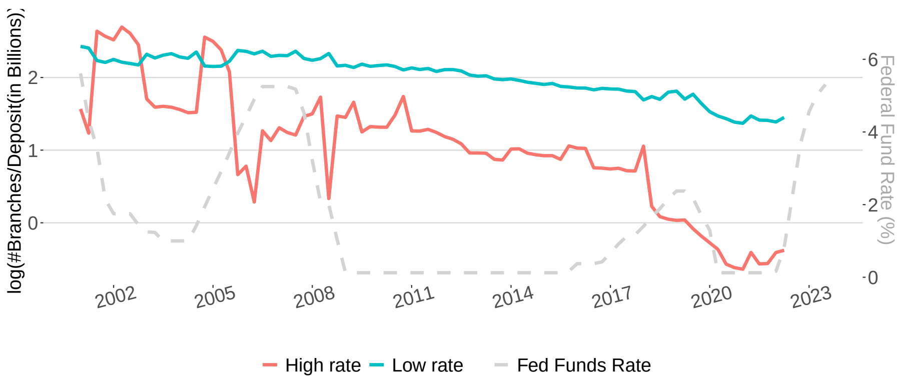
Notes: This figure displays kernel density plots of the demeaned logarithm of branch deposits by the top 25 banks at the peak of each interest rate hiking cycle. Figures a, b, c, and d illustrate the kernel density at the following quarters: 2007Q3, 2019Q1, and 2022Q2 (the last quarter available in SOD database), respectively. The top 25 banks are determined based on bank size at the beginning of each quarter. To ensure that the results are not influenced by banks primarily engaged in businesses other than retail deposits, we limit our analysis to banks with a minimum of 15 branches (the sample average is 1214). This restriction excludes Charles Schwab, J.P. Morgan & Co (before 2000), State Street, Merrill Lynch, Morgan Stanley, Bank of New York Mellon, Goldman Sachs, Ally Financial, and ING. The first seven of these banks focus on broker or investment banking businesses, while the latter two are fintech banks that have emerged in recent years. In the Appendix Figure D.4, we provide density plots that include these banks without any exclusions.

Figure 5: Branches

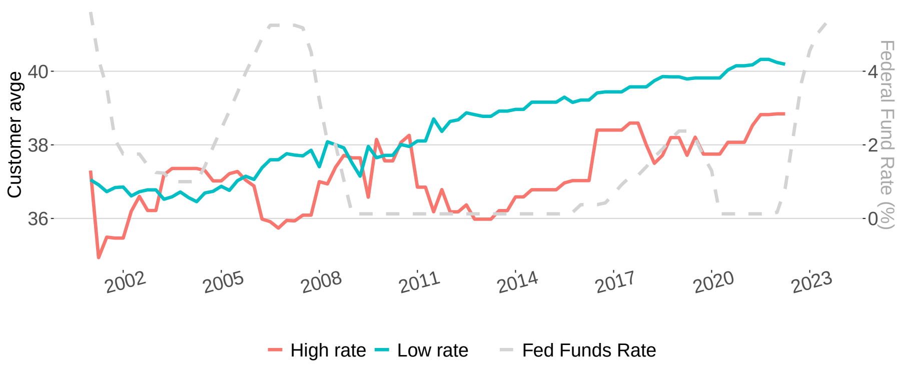
(a) Growth of Branches



(b) $\log \frac{\#Branches}{Deposits}$



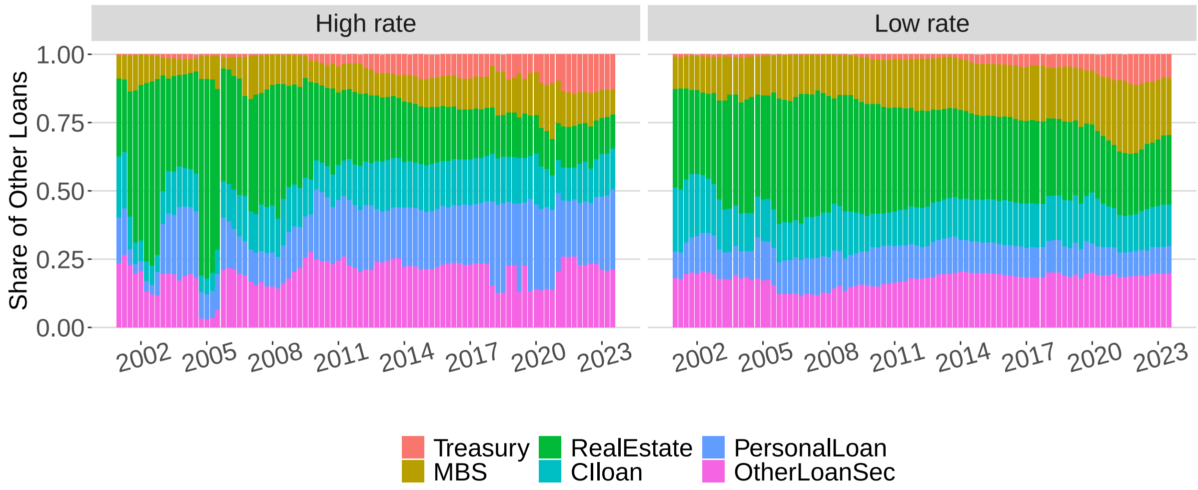
(c) Branch-weighted County Average Age



Notes: This figure compares branches operating by high and low rate banks among the top 25 banks from 2001Q1 through 2022Q2, which is the quarter where the most recent SOD data ends. Figure 5a presents the log-transformed number of branches of high and low rate banks. Figure 5b presents the log-transformed ratio between branches and deposits (in Billions) of high and low rate banks, where deposits are inflation-adjusted. Figure 5c presents the branch-weighted county average age of high and low rate banks. The left y-axis represents the quarterly average Federal Fund Target rate (Fed Funds Rate). A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MCD10K rate and deposit rate from the Call Report, falls within the top quintile.

Figure 6: Portfolio Composition

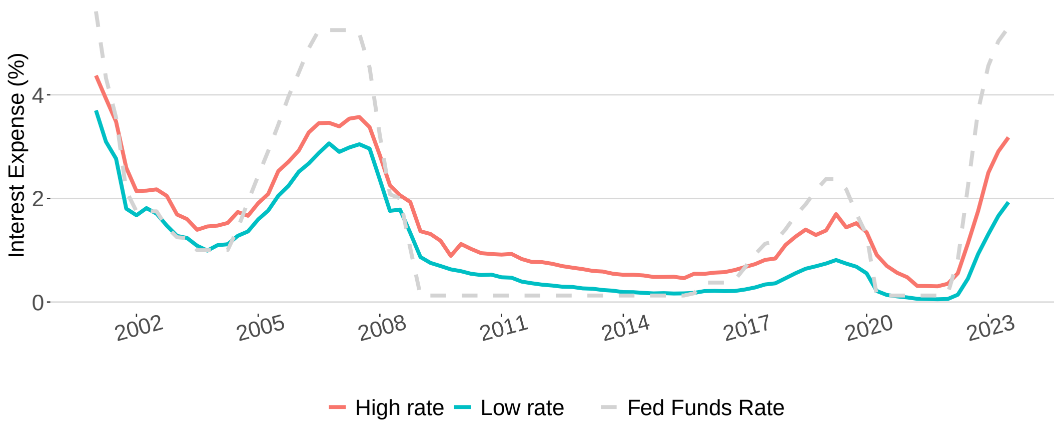
(a) Share of Assets



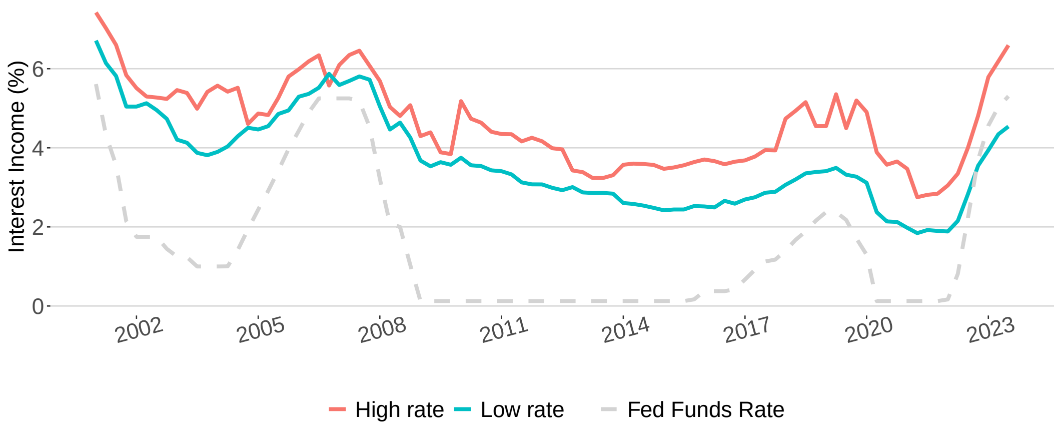
Notes: This figure compares the portfolio characteristics of high and low rate banks among the top 25 banks from 2001Q1 through 2023Q3. Figure examines the portfolio composition of high rate and low rate banks; share of treasuries, mortgage-backed securities, real estate loans, and C&I loans loans, personal loans, and the rest loans and securities. See Appendix Table C.1 for more details on the construction of key variables. A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MCD10K rate and deposit rate from the Call Report, falls within the top quintile.

Figure 7: Net Interest Margin

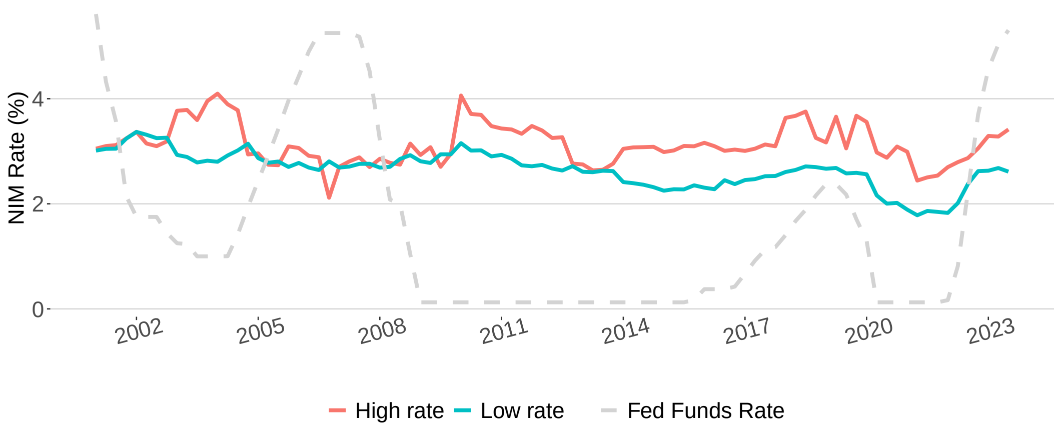
(a) Interest Expense



(b) Interest Income



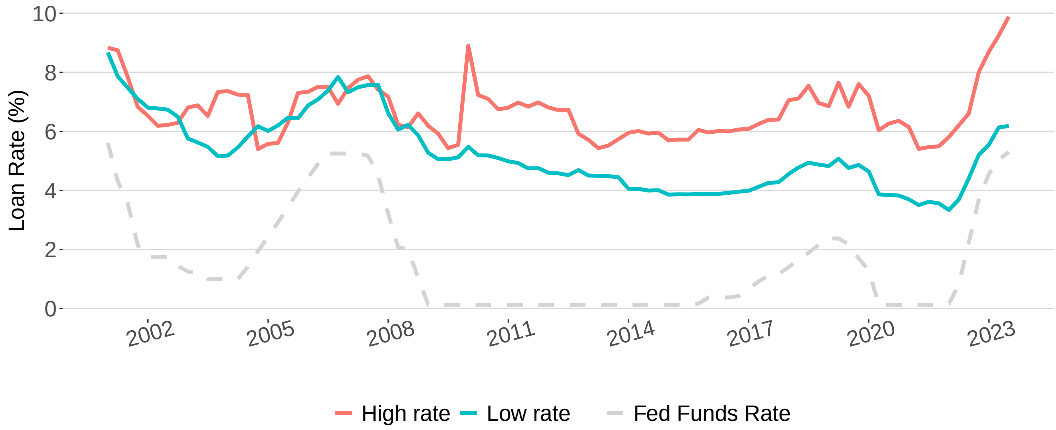
(c) NIM



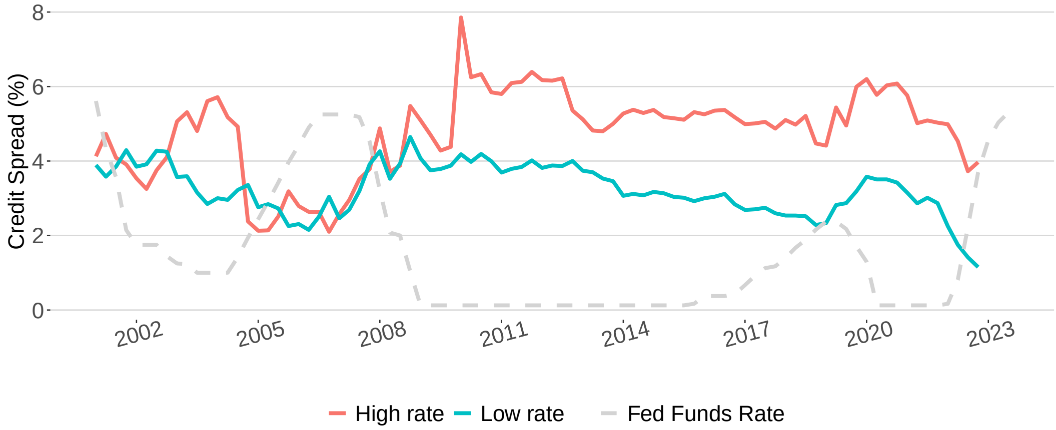
Notes: This figure compares the interest expense, interest income, and net interest margin of high and low rate banks among the top 25 banks from 2001Q1 through 2023Q3. Figure 7a presents the interest expense (%) of high and low rate banks. Figure 7b presents the interest income (%) of high and low rate banks. Figure 7c presents the net interest margin (NIM) rate (%) for high and low rate banks. See Appendix Table C.1 for more details on the construction of key variables. The left y-axis represents the quarterly average Federal Fund Target rate (Fed Funds Rate). A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MCD10K rate and deposit rate from the Call Report, falls within the top quintile.

Figure 8: Credit Risk

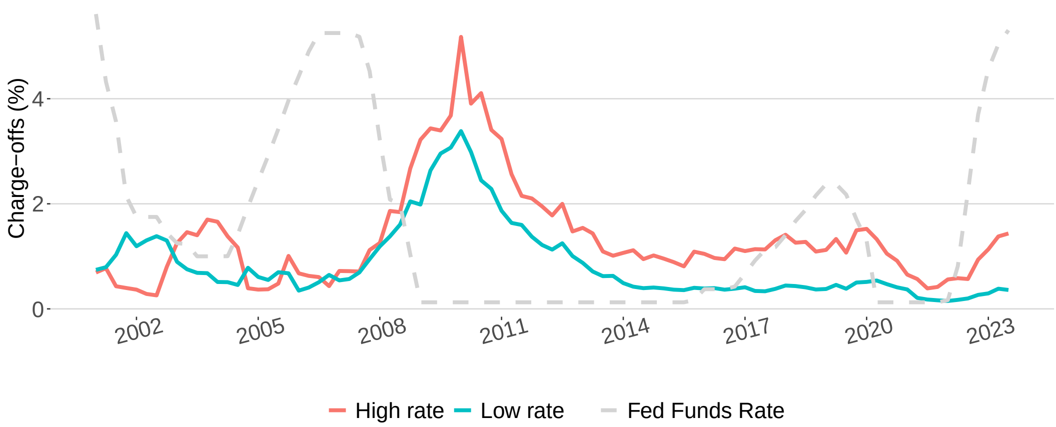
(a) Loan rate



(b) Credit spread



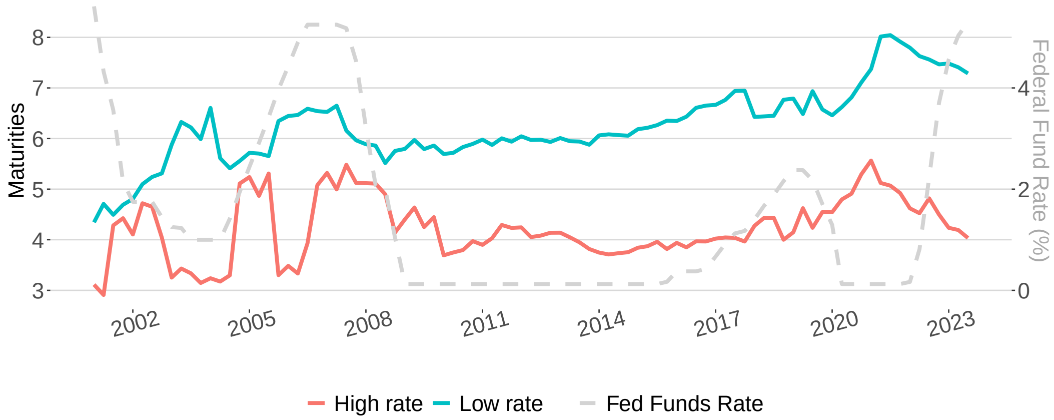
(c) Charge-offs



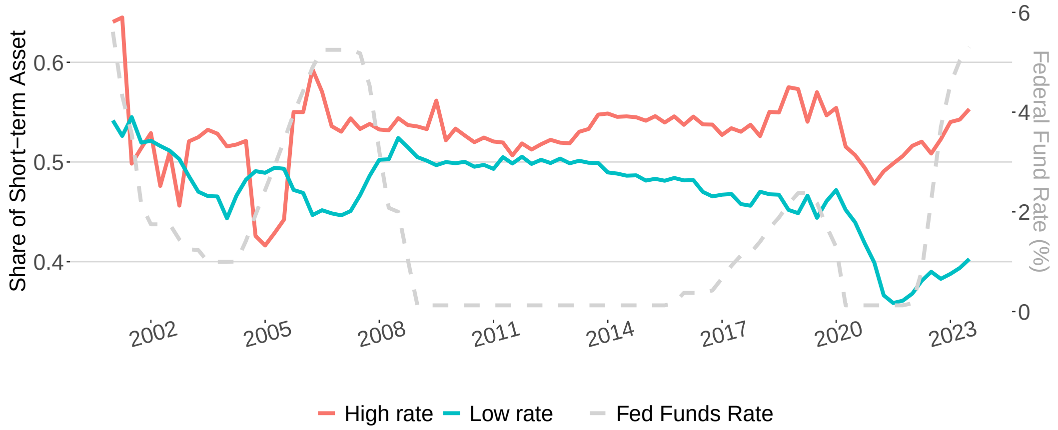
Notes: This figure compares the credit risk of high and low rate banks among the top 25 banks from 2001Q1 through 2023Q3. Figure 8a presents the loan rate (%) of high and low rate banks. Figure 8b presents the credit spread (%) of high and low rate banks. The credit spread is computed as the difference between the loan rate and synthetic term rate (average of term treasury yields, weighted by the share of loans with corresponding maturities). Figure 8c presents the charge-off rate (%) for high and low rate banks. See Appendix Table C.1 for more details on the construction of key variables. The left y-axis represents the quarterly average Federal Fund Target rate (Fed Funds Rate). A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MCD10K rate and deposit rate from the Call Report, falls within the top quintile.

Figure 9: Maturity

(a) Maturity



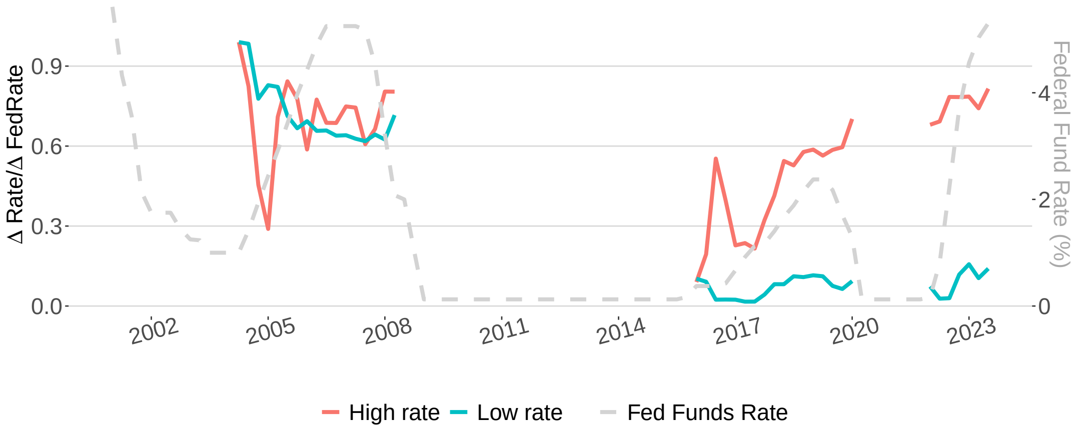
(b) Share of Short-Term Assets



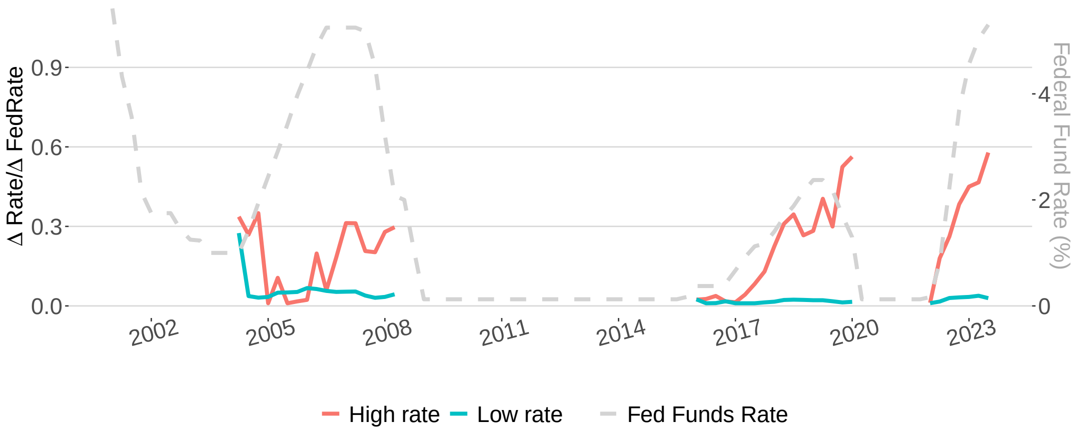
Notes: This figure compares the maturity risk of high and low rate banks among the top 25 banks from 2001Q1 through 2023Q3. Figure 9a presents the maturity (# of years) of high and low rate banks. Figure 9b presents the share of assets with less-than one-year maturity (short-term assets) for high and low rate banks. The left y-axis represents the quarterly average Federal Fund Target rate (Fed Funds Rate). A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MCD10K rate and deposit rate from the Call Report, falls within the top quintile.

Figure 10: Deposit Rate Sensitivity

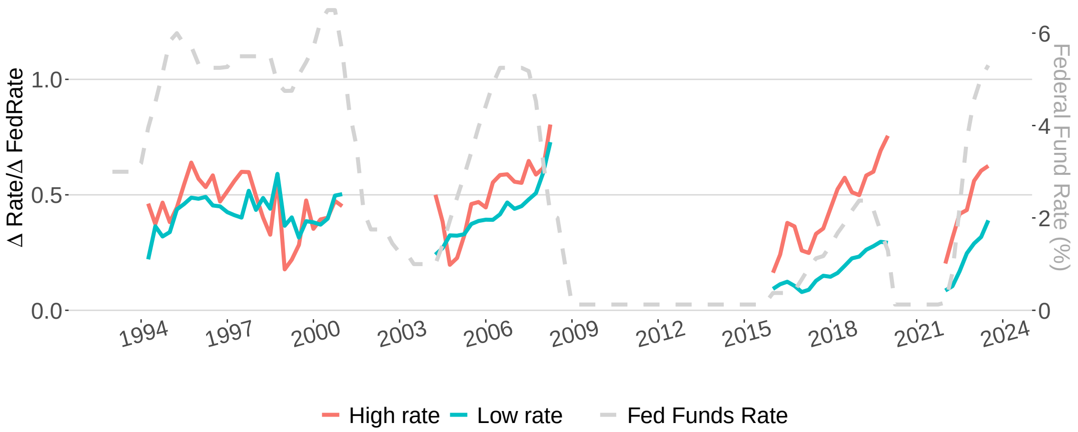
(a) 12MCD10K



(b) SAV



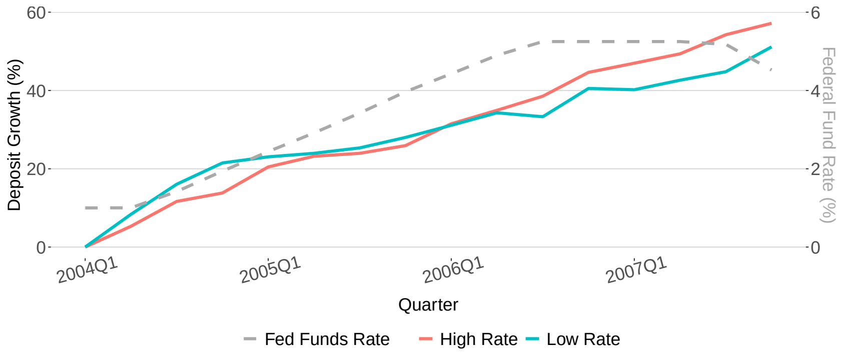
(c) DepRate



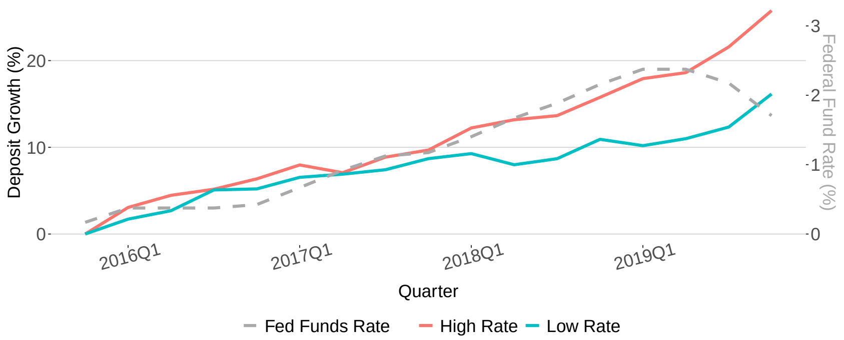
Notes: This figure compares the average deposit rate sensitivity of high and low rate banks among the top 25 banks over the three recent rate hiking cycles: 2004Q1 through 2008Q2, 2015Q4 through 2020Q1, and 2021Q4 through 2023Q3. The deposit rate sensitivity is defined as the ratio of the cumulative change in deposit rates from the first quarter of each rate hiking cycle to the corresponding change in the Federal Funds Target rate. We consider three deposit rates: the 12MCD10K rate in panel a, the savings rate in panel b, and the deposit rate calculated from the Call Report (DepRate) in panel c. The left y-axis represents the quarterly average Federal Fund Target rate (Fed Funds Rate). A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MCD10K rate and deposit rate from the Call Report, falls within the top quintile.

Figure 11: Deposit Growth

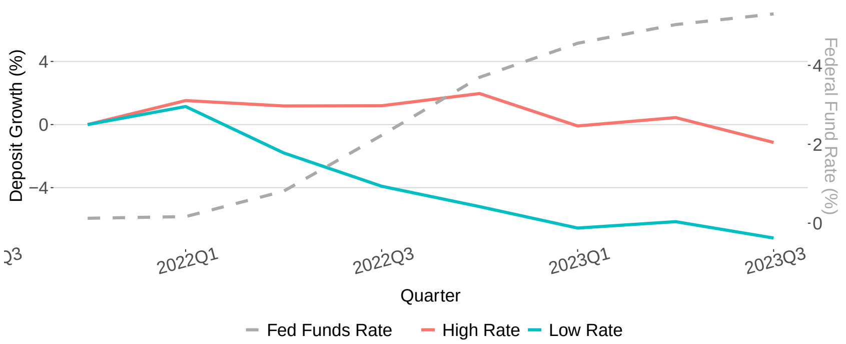
(a) 2004Q1-2007Q4



(b) 2015Q4-2019Q4



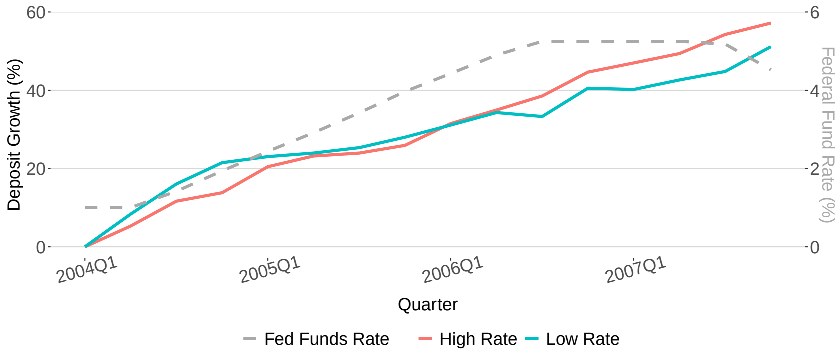
(c) 2021Q4-2023Q3



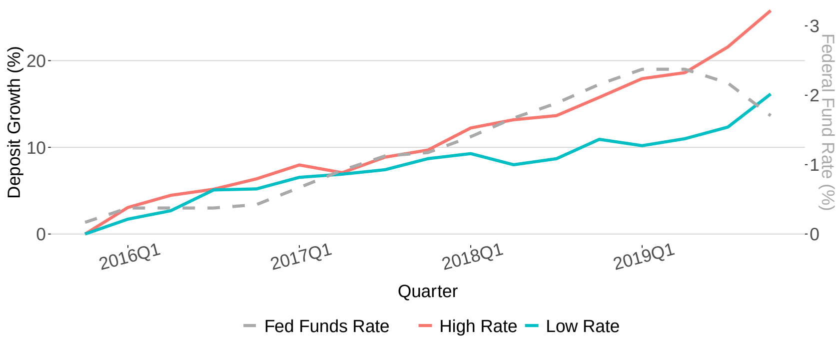
Notes: This figure compares the deposit growth of high and low rate banks among the top 25 banks over the three recent rate hiking cycles. Figures 12a, 12b, and 12c compare the deposit growth experienced by high rate banks to that of low rate banks from 2004Q1 through 2007Q4, from 2015Q4 through 2019Q4, and from 2021Q4 through 2023Q3, respectively. To facilitate comparison, the growth rates of high rate and low rate banks are normalized to 0% in the first quarter of each rate hiking cycle, i.e. 2004Q1, 2015Q4, and 2021Q4. The left y-axis represents the quarterly average Federal Fund Target rate (Fed Funds Rate). A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MCD10K rate and deposit rate from the Call Report, falls within the top quintile.

Figure 12: Deposit Growth

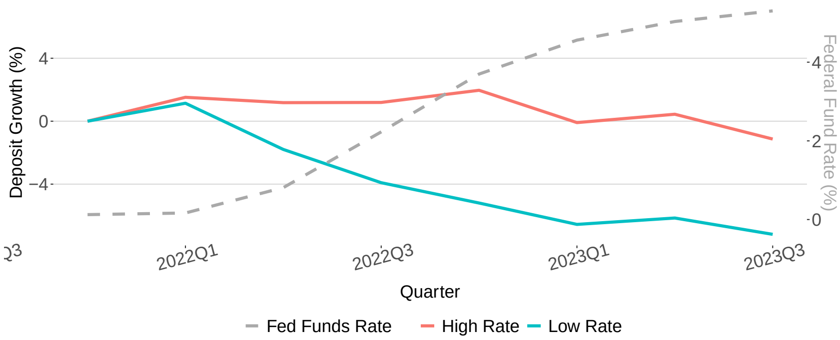
(a) 2004Q1-2007Q4



(b) 2015Q4-2019Q4



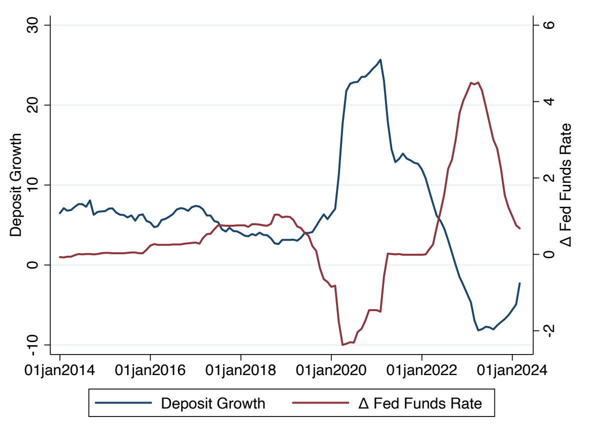
(c) 2021Q4-2023Q3



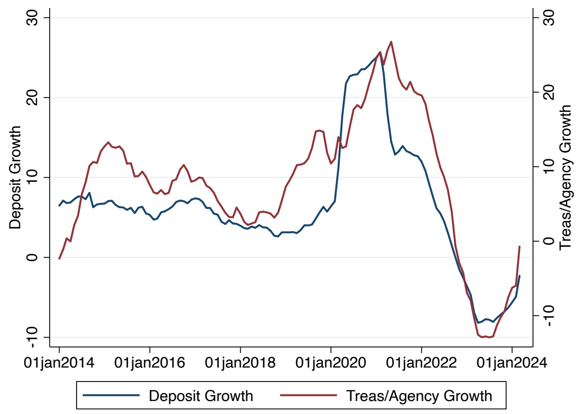
Notes: This figure compares the deposit growth of high and low rate banks among the top 25 banks over the three recent rate hiking cycles. Figures 12a, 12b, and 12c compare the deposit growth experienced by high rate banks to that of low rate banks from 2004Q1 through 2007Q4, from 2015Q4 through 2019Q4, and from 2021Q4 through 2023Q3, respectively. To facilitate comparison, the growth rates of high rate and low rate banks are normalized to 0% in the first quarter of each rate hiking cycle, i.e. 2004Q1, 2015Q4, and 2021Q4. The left y-axis represents the quarterly average Federal Fund Target rate (Fed Funds Rate). A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MCD10K rate and deposit rate from the Call Report, falls within the top quintile.

Figure 13: Monetary Policy and the Aggregate Growth of Deposits, Securities, and Loans

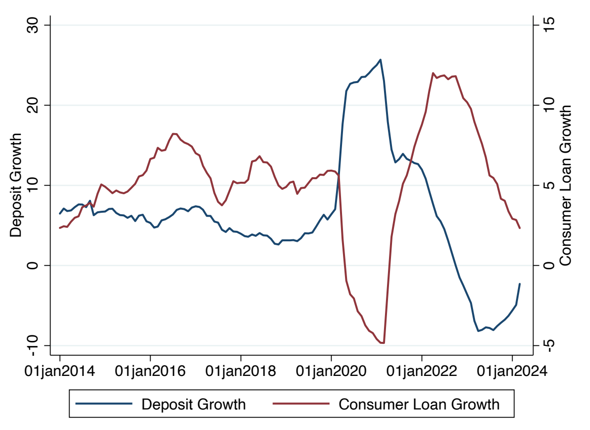
(a) Deposits and the Fed Funds Rate



(b) Treasuries and MBS



(c) Consumber Loans



Notes: This figure explores the impact of monetary policy changes on the growth of deposits, treasuries, MBSs, and consumer loans post-2014, utilizing data from the FRED database for all commercial banks. Panel (a) displays the annual changes in the Federal Funds rate alongside the annual growth in deposits. Panel (b) shows the annual growth of deposits and the annual growth of treasuries and MBSs, while Panel (c) illustrates the annual growth of consumer loans.

Table 1: Deposit Rates on Savings Accounts

Financial institution	**Savings deposit rate (APY)**	**Minimum opening balance**
PNC	4.65%	$0
Marcus by Goldman Sachs	4.50%	$0
Citi Bank	4.45%	$0
Ally Bank	4.35%	$0
Capital One	4.35%	$0
TD Bank	0.02%	$0
JP Morgan Chase	0.01%	$0
U.S. Bank	0.01%	$25
Wells Fargo	0.01%	$25
Bank of America	0.01%	$100

Notes: This table lists the annual percentage yield (APY) of saving accounts offered by financial institutions that are broadly available as well as some of the nation's largest banks, as of March 21, 2024. *Source:* BankRate.com, supplemented by authors survey of banks' webpages

Table 2: Summary Statistics

Panel A: High v.s. Low rate Banks Comparison

	2001-2008			2017-2023		
	High	Low	Diff	High	Low	Diff
MCD (%)	2.75	2.15	0.60***	0.77	0.04	0.73***
DepRate (%)	2.14	1.54	0.60***	0.64	0.11	0.53***
Insured Deposits Share	0.43	0.46	-0.02	0.43	0.45	-0.02
#Branches	949	2612	-1663***	406	3270	-2865***
$\log(\frac{\#\text{Branches}}{\text{Deposits}})$	0.40	1.32	-0.90***	-1.21	0.33	-1.54***
ΔDeposits (%)	2.47	2.75	-0.28	1.36	1.18	0.18
NIM rate (%)	2.54	2.33	0.21	2.52	1.78	0.74***
Maturity (Years)	3.71	5.23	-1.53***	3.93	6.45	-2.53***
Charge-off Rate (%)	0.61	0.41	0.20	0.39	0.03	0.36***

Panel B: Deposit Rate

	Count	Mean	Stdev	Skewness	P5	P25	Median	P75	P95
12MCD10K	1830	1.20	1.37	1.17	0.03	0.15	0.49	1.99	4.03
DepRate	2250	1.11	1.09	1.32	0.04	0.23	0.73	1.67	3.30

Notes: Panel A compares various metrics between high and low rate banks among the top 25 banks from 2001Q1 to 2008Q4 and from 2017Q1 to 2023Q3. The comparison between 2009Q1 to 2006Q4 is reported in Tabel C.2. A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MCD10K rate and deposit rate from the Call Report, falls within the top quintile. The averages, weighted by its asset size in the previous quarter, are reported separately for the two types of banks, as well as their difference. Standard errors are clustered at the quarter-year levels and are accounted for autocorrelation consistent errors using Driscoll-Kraay with 4-quarter lags. *, **, *** represent statistical significance at 10%, 5% and 1% level, respectively. CD refers to the 12-month certificate of deposit rate on accounts with at least $10,000, collected from RateWatch. DepRate is the deposit rate calculated from the Call Reports. The share of insured deposits, NIM rate, quarterly growth of deposits, maturity of loans and securities, charge-offs of loans are extracted from the Call Reports. Additionally, we count the number of branches for each bank using the Statement of Deposits (SOD). Panel B presents the summary statistics for DepRate and 12MCD10K from 2001Q1 to 2023Q3.

Table 3: Bank Branches

	log(# Branches)		$\log(\frac{\text{Branches}}{\text{Deposit}})$		Branch-weighted County Average Age	
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}$(High Rate)×Post	-1.072***	-1.049***	-0.477**	-0.547**	-0.568***	-0.567***
	(0.298)	(0.303)	(0.229)	(0.238)	(0.215)	(0.214)
$\mathbb{1}$(High Rate)	-0.785***	-0.861***	-1.120***	-1.151***	-0.470**	-0.557***
	(0.218)	(0.208)	(0.192)	(0.194)	(0.197)	(0.185)
Post	0.443***		-0.779***		1.820***	
	(0.126)		(0.121)		(0.213)	
Controls	✓	✓	✓	✓	✓	✓
Quarter FE		✓		✓		✓
Adjusted R^2	0.152	0.156	0.152	0.125	0.322	0.162
Observations	2112	2112	2112	2112	1647	1647
Mean of Dep. Variable	7.088	7.088	0.852	0.852	38.657	38.657

Notes: This table reports the estimated coefficients from the following regression specification:

$$Y_{i,q} = \delta_q + \beta_1 \times \mathbb{1}_{\text{High rate},i} \times \text{Post}_q + \beta_2 \times \mathbb{1}_{\text{High rate},i} + \beta_3 \times Controls_{i,q-1} + \varepsilon_{i,q},$$

where i and q indicate the bank and quarter-year, respectively, $\mathbb{1}_{\text{High rate}_i}$ denotes whether bank i is a high rate bank, $Post_t$ denotes the post-2009 period. Controls include $\text{ROA}_{i,q-1}$ and Tier $1_{i,q-1}$, which represent the return on assets and the tier 1 capital ratio from the previous quarter, respectively. The dependent variable, $Y_{i,q}$ is the log-transformed number of branches (log(# of Branches)) in columns (1)-(2), the log-transformed ratio of branches to deposits in billions ($\log(\frac{Branches}{Deposit})$) in columns (3)-(4), and the average customer age in columns (5)-(6). The branch-weighted county average age is calculated as the county average age, which is weighted based on the number of branches in each county. The variable $\log(\frac{Branches}{Deposit})$ is winsorized at the 0.5% and the 99.5% levels. Branch and deposit data comes from the FDIC Summary of Deposits. A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MCD10K rate and deposit rate from the Call Report, falls within the top quintile. Each observation is weighted by its asset size in the previous quarter. Standard errors (in parentheses) are clustered at the quarter-year levels and are accounted for autocorrelation consistent errors using Driscoll-Kraay with 4-quarter lags. *, **, *** represent statistical significance at 10%, 5% and 1% level, respectively.

Table 4: Credit Risk

Panel A: Loans and Securities

	Loan Rate	Credit Spread	Charge-offs
	(1)	(2)	(3)
$\mathbb{1}$(High Rate)×Post	1.385***	1.194***	0.440***
	(0.212)	(0.278)	(0.136)
$\mathbb{1}$(High Rate)	0.703***	1.011***	0.251**
	(0.189)	(0.269)	(0.124)
Controls + Quarter FE	✓	✓	✓
Adjusted R^2	0.327	0.346	0.166
Observations	2269	2103	2269
Mean of Dep. Variable	5.172	3.411	0.859

Panel B: Charge-off Rates by Asset Class

	Real Estate Loans	C&I Loans	Personal Loans	Other Loans
	(1)	(2)	(3)	(4)
$\mathbb{1}$(High Rate)×Post	0.224**	0.209**	0.614***	0.062
	(0.089)	(0.086)	(0.185)	(0.067)
$\mathbb{1}$(High Rate)	0.049	0.049	0.570***	-0.050
	(0.050)	(0.067)	(0.168)	(0.058)
Controls + Quarter FE	✓	✓	✓	✓
Adjusted R^2	0.079	0.027	0.092	0.001
Observations	2239	2214	2264	2243
Mean of Dep. Variable	0.445	0.594	2.328	0.226

Notes: This table reports the estimated coefficients from the following regression specification:

$$Y_{i,q} = \delta_q + \beta_1 \times \mathbb{1}_{\text{High rate},i} \times \text{Post}_q + \beta_2 \times \mathbb{1}_{\text{High rate},i} + \beta_3 \times Controls_{i,q-1} + \varepsilon_{i,q}$$

where i and q indicate the bank and quarter-year, respectively, $\mathbb{1}_{\text{High rate}_i}$ denotes whether bank i is a high rate bank, $Post_t$ denotes the post-2009 period. Controls include $\text{ROA}_{i,q-1}$ and Tier $1_{i,q-1}$, which represent the return on assets and the tier 1 capital ratio from the previous quarter, respectively. In panel A, the dependent variable, $Y_{i,q}$ is the loan rate in column (1), credit spread in column (2), and charge-off rate in column (3). The credit spread is computed as the difference between the loan rate and synthetic term rate (average of treasury yields, weighted by the share of loans with different maturities). Panel B analyzes the charge-off rate by asset class. The asset classes are real estate loans in column (1), other loans in column (2), mortgage-backed securities in column (3), and treasuries in column (4). All dependent variables are winsorized at the 0.5% and 99.5% levels. A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MCD10K rate and deposit rate from the Call Report, falls within the top quintile. Each observation is weighted by its asset size in the previous quarter. Standard errors (in parentheses) are clustered at the quarter-year levels and are accounted for autocorrelation consistent errors using Driscoll-Kraay with 4-quarter lags. *, **, *** represent statistical significance at 10%, 5% and 1% level, respectively.

Table 5: Maturity risk

Panel A: Loans and Securities

	Maturities (years)	Short-term share (%)
	(1)	(2)
$\mathbb{1}$(High Rate)×Post	-0.710**	3.012*
	(0.332)	(1.582)
$\mathbb{1}$(High Rate)	-1.793***	6.140***
	(0.327)	(1.142)
Controls + Quarter FE	✓	✓
Adjusted R^2	0.227	0.129
Observations	2178	2178
Mean of Dep. Variable	5.934	47.872

Panel B: Share by Asset Classes (%)

	Real Estate Loans	Other Loans	MBSs	Treasuries
	(1)	(2)	(3)	(4)
$\mathbb{1}$(High Rate)×Post	-2.214	4.378**	-1.015	-1.149
	(2.001)	(1.931)	(0.650)	(1.995)
$\mathbb{1}$(High Rate)	-3.385*	5.525***	-6.759***	4.619**
	(1.971)	(1.791)	(0.695)	(1.886)
Controls + Quarter FE	✓	✓	✓	✓
Adjusted R^2	0.111	0.093	0.142	0.032
Observations	2178	2178	2178	2178
Mean of Dep. Variable	15.092	57.634	12.340	14.933

Panel C: Maturity by Asset Class

	Real Estate Loans	Other Loans	MBSs	Treasuries
	(1)	(2)	(3)	(4)
$\mathbb{1}$(High Rate)×Post	0.059	0.120	-0.958**	-1.795***
	(0.280)	(0.175)	(0.398)	(0.587)
$\mathbb{1}$(High Rate)	-1.764***	-0.599***	1.464***	-0.119
	(0.236)	(0.163)	(0.315)	(0.546)
Controls + Quarter FE	✓	✓	✓	✓
Adjusted R^2	0.073	0.106	0.095	0.055
Observations	2074	2178	2091	2139
Mean of Dep. Variable	12.255	1.944	17.161	5.982

Notes: This table reports the estimated coefficients from the following regression specification:

$$Y_{i,q} = \delta_q + \beta_1 \times \mathbb{1}_{\text{High rate},i} \times \text{Post}_q + \beta_2 \times \mathbb{1}_{\text{High rate},i} + \beta_3 \times Controls_{i,q-1} + \varepsilon_{i,q},$$

where i and q indicate the bank and quarter-year, respectively, $\mathbb{1}_{\text{High rate}_i}$ denotes whether bank i is a high rate bank, $Post_t$ denotes the post-2009 period. Controls include $\text{ROA}_{i,q-1}$ and Tier $1_{i,q-1}$, which represent the return on assets and the tier 1 capital ratio from the previous quarter, respectively. In panel A, the dependent variable, $Y_{i,q}$ is the maturity of loans and securities in column (1), and the share of loans and securities with less than one-year maturity in column (2). Panels B and C analyze asset share by asset classes and corresponding maturities. The asset classes are real estate loans in column (1), other loans in column (2), mortgage-backed securities in column (3), and treasuries in column (4). The data comes from the Call Reports. A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MCD10K rate and deposit rate from the Call Report, falls within the top quintile. Each observation is weighted by its asset size in the previous quarter. Standard errors (in parentheses) are clustered at the quarter-year levels and are accounted for autocorrelation consistent errors using Driscoll-Kraay with 4-quarter lags. *, **, *** represent statistical significance at 10%, 5% and 1% level, respectively.

Table 6: Asset Composition Shift

	Personal Loans	C&I loans	Real Estate	Other Loans	MBS	Other Securities
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}$(High Rate)×Post	7.449***	3.122**	-12.560***	3.244***	-3.083***	1.829
	(1.840)	(1.283)	(3.058)	(0.836)	(1.129)	(1.350)
$\mathbb{1}$(High Rate)	3.861**	-2.533*	3.274	-0.641	-7.121***	3.161**
	(1.695)	(1.284)	(3.124)	(0.813)	(1.112)	(1.242)
Controls + Quarter FE	✓	✓	✓	✓	✓	✓
Adjusted R^2	0.234	0.032	0.076	0.042	0.160	0.052
Observations	2269	2269	2269	2269	2269	2269
Mean of Dep. Variable	13.395	15.118	29.950	11.445	16.888	13.204

Notes: This table reports the estimated coefficients from the following regression specification:

$$Y_{i,q} = \delta_q + \beta_1 \times \mathbb{1}_{\text{High rate},i} \times \text{Post}_q + \beta_2 \times \mathbb{1}_{\text{High rate},i} + \beta_3 \times Controls_{i,q-1} + \varepsilon_{i,q}$$

where i and q indicate the bank and quarter-year, respectively, $\mathbb{1}_{\text{High rate}_i}$ denotes whether bank i is a high rate bank, $Post_t$ denotes the post-2009 period. Controls include $\text{ROA}_{i,q-1}$ and Tier $1_{i,q-1}$, which represent the return on assets and the tier 1 capital ratio from the previous quarter, respectively. The dependent variable, $Y_{i,q}$, represents the share of different asset types in total loans and securities for each bank: personal loans (column 1), C&I loans (column 2), real estate loans (column 3), other loans (column 4), MBS (column 5), and other securities (column 6). The data comes from the Call Reports. A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MCD10K rate and deposit rate from the Call Report, falls within the top quintile. Each observation is weighted by its asset size in the previous quarter. Standard errors (in parentheses) are clustered at the quarter-year levels and are accounted for autocorrelation consistent errors using Driscoll-Kraay with 4-quarter lags. *, **, *** represent statistical significance at 10%, 5% and 1% level, respectively.

Table 7: Additional Results

	IT Exp	Noninterest Expense Rate (%)	Noninterest Income Rate (%)	Tier 1+2 Ratio (%)	Reserve Share (%)	Insured Deposits Share (%)	Wholesale Share (%)	Wholesale Rate (%)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\mathbb{1}$(High Rate)×Post	0.021***	-0.040	0.072	0.028	-0.004	-0.033	-0.026**	1.178***
	(0.006)	(0.166)	(0.209)	(0.208)	(0.008)	(0.035)	(0.013)	(0.226)
$\mathbb{1}$(High Rate)	-0.004	0.189	-0.197	1.325***	0.007**	-0.057*	0.032**	-0.016
	(0.005)	(0.144)	(0.198)	(0.165)	(0.003)	(0.029)	(0.013)	(0.107)
Controls + Quarter FE	✓	✓	✓	✓	✓	✓	✓	✓
Adjusted R^2	0.225	0.044	0.125	0.066	0.024	0.088	0.018	0.057
Observations	1312	2269	2269	2269	2269	2269	2269	2234
Mean of Dep. Variable	0.033	2.646	1.823	14.306	0.064	0.458	0.130	2.753

Notes: This table reports the estimated coefficients from the following regression specification:

$$Y_{i,q} = \delta_q + \beta_1 \times \mathbb{1}_{\text{High rate},i} \times \text{Post}_q + \beta_2 \times \mathbb{1}_{\text{High rate},i} + \beta_3 \times Controls_{i,q-1} + \varepsilon_{i,q}$$

where i and q indicate the bank and quarter-year, respectively, $\mathbb{1}_{\text{High rate}_i}$ denotes whether bank i is a high rate bank, $Post_t$ denotes the post-2009 period. Controls include $\text{ROA}_{i,q-1}$ and Tier $1_{i,q-1}$, which represent the return on assets and the tier 1 capital ratio from the previous quarter, respectively. The dependent variable, $\Delta \text{Y}_{i,y}$ is IT expense ratio, non-interest expense, non-interest income, Tier 1 and 2 ratio, reserve ratio, insured deposit share, wholesale funding share and wholesale funding rate. A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MCD10K rate and deposit rate from the Call Report, falls within the top quintile. Each observation is weighted by its asset size in the previous quarter. Standard errors (in parentheses) are clustered at the quarter-year levels and are accounted for autocorrelation consistent errors using Driscoll-Kraay with 4-quarter lags. *, **, *** represent statistical significance at 10%, 5% and 1% level, respectively.

Table 8: Transmission of Monetary Policy: Deposit and Lending Rates

	Liabilities			Assets	Assets - Liability
	Δ12MCD10K	SavRate	ΔInterest Expense	ΔInterest Income	ΔNIM
	(1)	(2)	(3)	(4)	(5)
ΔFed Funds×𝟙(High Rate)×Post	0.545***	0.588***	0.170***	0.097	-0.064
	(0.115)	(0.178)	(0.037)	(0.070)	(0.049)
ΔFed Funds×𝟙(High Rate)	-0.066	-0.261***	-0.032	-0.025	-0.001
	(0.113)	(0.050)	(0.035)	(0.066)	(0.041)
ΔFed Funds×Post	-0.455***	-0.088**	-0.147***	0.112*	0.250***
	(0.099)	(0.037)	(0.051)	(0.065)	(0.044)
ΔFed Funds	0.599***	0.103***	0.463***	0.413***	-0.043
	(0.055)	(0.035)	(0.037)	(0.056)	(0.036)
Controls	✓	✓	✓	✓	✓
Adjusted R^2	0.558	0.150	0.592	0.367	0.095
Observations	1846	863	2268	2268	2268
Mean of Dep. Variable	-0.020	0.096	0.001	-0.009	-0.010

Notes: This table reports the estimated coefficients from the following regression specification:

$$
\begin{aligned}
\Delta Y_{i,q} = {} & \alpha + \beta_1 \times \Delta\text{Fed Funds}_q \times \mathbb{1}_{\text{High rate},i} \times \text{Post}_q + \beta_2 \times \Delta\text{Fed Funds}_q \times \mathbb{1}_{\text{High rate},i} \\
& + \beta_3 \times \Delta\text{Fed Funds}_q \times \text{Post}_q + \beta_4 \times \Delta\text{Fed Funds}_q + \beta_5 \times \mathbb{1}_{\text{High rate},i} \\
& + \beta_6 \times \mathbb{1}_{\text{High rate},i} \times \text{Post}_q + \beta_7 \times Controls_{i,q-1} + \varepsilon_{i,q},
\end{aligned}
$$

where i and q indicate the bank and quarter-year, respectively, ΔFed Funds$_q$ denotes the change in the Federal Funds Target Rate, $\mathbb{1}_{\text{High rate}_i}$ denotes whether bank i is a high rate bank, $Post_t$ denotes the post-2009 period. Controls include ROA$_{i,q-1}$ and Tier 1$_{i,q-1}$, which represent the return on assets and the tier 1 capital ratio from the previous quarter, respectively. The dependent variable, $\Delta Y_{i,q}$ is the change in the 12MCD10K rate in column (1), the change in the saving rate in column (2), the change in interest expense in column (3), the change in net interest income in column (4), and the change in NIM in column (5). All dependent variables are winsorized at the 0.5% and the 99.5% levels. The 12MCD10K and saving rates comes from RateWatch. The change in interest expense, interest income and NIM are computed from the Call Reports. See Table C.1 for more details on the construction of key variables. A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MCD10K rate and deposit rate from the Call Report, falls within the top quintile. Each observation is weighted by its asset size in the previous quarter. Standard errors (in parentheses) are clustered at the quarter-year levels and are accounted for autocorrelation consistent errors using Driscoll-Kraay with 4-quarter lags. *, **, *** represent statistical significance at 10%, 5% and 1% level, respectively.

Table 9: Reallocation of Deposits and Lending During Monetary Policy Cycles

	ΔDeposit$_{i,y}$		ΔPersonal Loan$_{i,y}$		ΔC&I Loan$_{i,y}$		ΔRE Loan$_{i,y}$		ΔMBS$_{i,y}$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ΔFed Funds$_y\times$ $\mathbb{1}$(High Rate)$\times$Post	3.252**	2.873**	4.636*	5.379*	5.301**	3.470	0.079	0.626	-18.186**	-16.469**
	(1.361)	(1.388)	(2.727)	(2.829)	(2.587)	(2.612)	(2.548)	(2.841)	(7.628)	(7.444)
ΔFed Funds$_y$ $\times$ $\mathbb{1}$(High Rate)	-0.647	-0.603	-3.468*	-3.996*	-3.464**	-1.657	-0.340	-0.769	21.185***	19.344***
	(0.913)	(0.884)	(2.024)	(2.156)	(1.652)	(1.812)	(1.421)	(1.414)	(7.494)	(7.260)
ΔFed Funds$_y\times$Post	-5.199***		-0.799		-1.992		-2.717		0.461	
	(1.172)		(1.102)		(2.094)		(1.947)		(2.259)	
ΔFed Funds$_y$	0.733		0.819		1.868		2.522**		-5.355**	
	(0.689)		(0.872)		(1.901)		(0.990)		(2.111)	
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Quarter FE		✓		✓		✓		✓		✓
Adjusted R^2	0.227	0.044	0.032	0.008	0.029	0.012	0.110	0.029	0.101	0.054
Observations	2252	2252	2243	2243	2187	2187	2215	2215	2197	2197
Mean of Dep. Variable	8.148	8.148	6.442	6.442	5.780	5.780	5.629	5.629	9.181	9.181

Notes: This table reports the estimated coefficients from the following regression specification:

$$\begin{aligned}\Delta \mathrm{Y}_{i,y} = \alpha + \beta_1 \times \Delta\text{Fed Funds Rate}_y \times \mathbb{1}_{\text{High rate},i} \times \text{Post}_q + \beta_2 \times \Delta\text{Fed Funds Rate}_y \times \mathbb{1}_{\text{High rate},i} + \\ \beta_3 \times \Delta\text{Fed Funds Rate}_y \times \text{Post}_q + \beta_4 \times \Delta\text{Fed Funds Rate}_y + \beta_5 \times \mathbb{1}_{\text{High rate},i} + \beta_6 \times \mathbb{1}_{\text{High rate},i} \times \text{Post}_q \\ \beta_7 \times \Delta\text{Fed Funds Rate}_y \times \mathbb{1}_{\text{High rate},i} \times \text{Crisis} + \beta_8 \times Controls_{i,q-1} + \varepsilon_{i,q},\end{aligned} \tag{5}$$

where i and q indicate the bank and quarter-year, respectively, ΔFed Funds Rate$_y$ denotes the one-year change in the Federal Funds Target Rate, $\mathbb{1}_{\text{High rate}_i}$ denotes whether bank i is a high rate bank, Post$_q$ denotes the post-2009 period, Crisis is an indicator for the third and fourth quarters of 2008. Controls include ROA$i, q-1$ and Tier 1$i, q-1$, which represent the return on assets and the tier 1 capital ratio from the previous quarter, respectively. The dependent variable, $\Delta \mathrm{Y}_{i,y}$ is the one-year growth of the total deposit, loans to individuals, C&I loans, treasury securities and MBS of bank i, and are winsorized at the 0.5% and the 99.5% levels. A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MCD10K rate and deposit rate from the Call Report, falls within the top quintile. Each observation is weighted by its asset size in the previous quarter. Standard errors (in parentheses) are clustered at the quarter-year levels and are accounted for autocorrelation consistent errors using Driscoll-Kraay with 4-quarter lags. *, **, *** represent statistical significance at 10%, 5% and 1% level, respectively.

Table 10: Changes in Lending Rates During Monetary Policy Cycles

	ΔNon CreditCard Personal Loan Rate$_{i,y}$		ΔC&I Loan Rate$_{i,y}$		ΔMBS Rate$_{i,y}$	
	(1)	(2)	(3)	(4)	(5)	(6)
ΔFed Funds$_y$ × $\mathbb{1}$(High Rate)×Post	0.006	-0.068	-0.182**	-0.209**	-0.234	-0.228
	(0.137)	(0.128)	(0.077)	(0.085)	(0.211)	(0.212)
ΔFed Funds$_y$ × $\mathbb{1}$(High Rate)	-0.057	0.005	0.069	0.094	0.272	0.272
	(0.128)	(0.119)	(0.059)	(0.070)	(0.201)	(0.201)
ΔFed Funds$_y$×Post	0.002		0.128		0.114	
	(0.150)		(0.080)		(0.081)	
ΔFed Funds$_y$	0.451***		0.468***		0.185**	
	(0.146)		(0.072)		(0.078)	
Controls	✓	✓	✓	✓	✓	✓
Quarter FE		✓		✓		✓
Adjusted R^2	0.302	0.002	0.498	0.007	0.168	0.014
Observations	1987	1987	2080	2080	1944	1944
Mean of Dep. Variable	5.326	5.326	4.331	4.331	3.404	3.404

Notes: This table reports the estimated coefficients from the following regression specification:

$$\begin{aligned}\Delta Y_{i,y} = \alpha + \beta_1 \times \Delta\text{Fed Funds Rate}_y \times \mathbb{1}_{\text{High rate},i} \times \text{Post}_q + \beta_2 \times \Delta\text{Fed Funds Rate}_y \times \mathbb{1}_{\text{High rate},i} + \\ \beta_3 \times \Delta\text{Fed Funds Rate}_y \times \text{Post}_q + \beta_4 \times \Delta\text{Fed Funds Rate}_y + \beta_5 \times \mathbb{1}_{\text{High rate},i} + \beta_6 \times \mathbb{1}_{\text{High rate},i} \times \text{Post}_q \\ \beta_7 \times \Delta\text{Fed Funds Rate}_y \times \mathbb{1}_{\text{High rate},i} \times \text{Crisis} + \beta_8 \times Controls_{i,q-1} + \varepsilon_{i,q},\end{aligned} \tag{6}$$

where i and q indicate the bank and quarter-year, respectively, ΔFed Funds Rate$_y$ denotes the one-year change in the Federal Funds Target Rate, $\mathbb{1}_{\text{High rate}_i}$ denotes whether bank i is a high rate bank, Post$_q$ denotes the post-2009 period, Crisis is an indicator for the third and fourth quarters of 2008. Controls include ROA$i, q-1$ and Tier 1$i, q-1$, which represent the return on assets and the tier 1 capital ratio from the previous quarter, respectively. The dependent variable, $\Delta Y_{i,y}$ is the one-year growth of the total deposit, loans to individuals, C&I loans, treasury securities and MBS of bank i, and are winsorized at the 0.5% and the 99.5% levels. A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MCD10K rate and deposit rate from the Call Report, falls within the top quintile. Each observation is weighted by its asset size in the previous quarter. Standard errors (in parentheses) are clustered at the quarter-year levels and are accounted for autocorrelation consistent errors using Driscoll-Kraay with 4-quarter lags. *, **, *** represent statistical significance at 10%, 5% and 1% level, respectively.

A Proofs

A.1 Solving the Model without Remote Banking Services

Considering the symmetry of the banks, two banks position their branches equidistantly around a circle. Without loss of generality, we assume that Bank A is located at position 0, while Bank B is located at position $1/2$. Depositors located at s and $1-s$ has a distance s to bank A and $1/2-s$ to bank B. In the case, depositors located at $\tilde{s} = \frac{r_A - r_B + \eta/2}{2\eta}$ and $1-\tilde{s}$ are indifferent between bank A and B. This leads to the following demands for two banks:

$$D_A = \frac{\eta/2 + (r_A - r_B)}{\eta}, \qquad D_B = \frac{\eta/2 - (r_A - r_B)}{\eta}.$$

Solving the equations (3), the first order conditions with respect to deposit rates are

$$r_A = \frac{1}{2}(f - \eta/2 + l_A + r_B), \quad r_B = \frac{1}{2}(f - \eta/2 + l_B + r_A).$$

Solving the equations (3), the first order conditions with respect to risk levels are

$$p(l_A) + (f + l_A - r_A)p'(l_A) = 0, \quad p(l_B) + (f + l_B - r_B)p'(l_B) = 0.$$

Based on the first two questions, we have

$$f + l_A - r_A = r_A - r_B + \eta/2, \quad f + l_B - r_B = r_B - r_A + \eta/2.$$

This gives

$$p(l_A) + (r_A - r_B + \eta/2)p'(l_A) = p(l_B) + (r_B - r_A + \eta/2)p'(l_B) = 0.$$

$$\Longrightarrow p(l_A) - p(l_B) = \frac{\eta}{2}\Big(p'(l_B) - p'(l_A)\Big) + \frac{l_B - l_A}{3}\Big(p'(l_B) + p'(l_A)\Big).$$

If $l_A > l_B$, the left side of the equation becomes negative, owing to the condition $p'(\cdot) < 0$. In contrast, the right side remains positive because of $p''(\cdot) \le 0$. Such a scenario is not feasible, leading to the conclusion that $l_A \le l_B$. Applying the same reasoning, we can also deduce that $l_A \ge l_B$. Consequently, it follows that $l_A = l_B = l^*$, where $p(l^*) + \frac{\eta}{2}p'(l^*) = 0$, and $r_A = r_B = f + l^* - \eta/2$. Under the assumption that $p(l) = \alpha - l$, $l^* = \alpha - \frac{\eta}{2}$.

A.2 Solving the Model during Mobile Banking Era

We separately discuss all possible equilibria during mobile banking era.

- Case 1 {A: E-banking only, B: E-banking only}. In this case, two banks provide homogeneous deposit products, and hence the deposit market is perfectly competitive, resulting in 0 profit for both banks:
$$prof_A^1 = prof_B^1 = 0.$$

- Case 2 {A: Branch + E-banking, B: Branch + E-banking}. In this case, the banks maintain their symmetry. Proceeding with the methodology as in the baseline model, we derive the following results:

$$r_A = r_B = f + l^* - \eta/2 = r^*, \qquad prof_A^2 = prof_B^2 = \frac{\eta}{4}p(l^*) = \frac{\eta^2}{8} - \kappa,$$

  where $-\frac{p'(l^*)}{p(l^*)} = \frac{2}{\eta} \Longrightarrow l^* = \alpha - \frac{\eta}{2}$, the same as in the case without mobile banking.

- Case 3 {A: Branch only, B: Branch + E-banking}. In this case, the objective functions of banks can be written as follows:

$$\max_{l_A, r_A} p(l_A)(f + l_A - r_A)\frac{\eta/2 + r_A - r_B - \gamma}{\eta} - \kappa,$$

$$\max_{l_B, r_B} p(l_B)(f + l_B - r_B)\frac{\eta/2 + r_B - r_A + \gamma}{\eta} - \kappa.$$

  The equilibrium is characterized as

$$r_A = r^* + \frac{2\gamma}{5}, \quad r_B = r^* - \frac{3c_M + 2\gamma}{5}$$

$$l_A = l^* + \frac{\gamma}{5}, \quad l_B = l^* - \frac{\gamma}{5},$$

$$Prof_A^3 = \frac{(-2\gamma + 5\eta)^3}{1000\eta} - \kappa, \quad Prof_B^3 = \frac{(2\gamma + 5\eta)^3}{1000\eta} - \kappa.$$

- Case 4 {A: Branch only, B: E-banking only}. In this case, the objective functions of banks can be written as follows:

$$\max_{l_A, r_A} p(l_A)(f + l_A - r_A)\frac{\eta + 2r_A - 2r_B - 2\gamma}{\eta} - \kappa,$$

$$\max_{l_B, r_B} p(l_B)(f + l_B - r_B)\frac{2r_B - 2r_A + 2\gamma}{\eta}.$$

  The equilibrium is characterized as

$$r_A = r^* + \frac{2\gamma + 2\eta}{5}, \quad r_B = r^* + \frac{-2\gamma + 3\eta}{5}$$

$$l_A = l^* + \frac{2\gamma + 2\eta}{10}, \quad l_B = l^* + \frac{-2\gamma + 3\eta}{10},$$

$$Prof_A^4 = \frac{(-2\gamma + 3\eta)^3}{500\eta} - \kappa, \quad Prof_B^4 = \frac{2(\gamma + \eta)^3}{125\eta}.$$

- Case 5 {A: Branch + E-banking, A: E-banking only}. In this case, the objective functions of banks can be written as follows:

$$\max_{l_A, r_A} p(l_A)(f + l_A - r_A)\frac{\eta + 2r_A - 2r_B}{\eta} - \kappa,$$

$$\max_{l_B, r_B} p(l_B)(f + l_B - r_B)\frac{2r_B - 2r_A}{\eta}.$$

  The equilibrium is characterized as

$$r_A = r^* + \frac{2\eta}{5}, \quad r_B = r^* + \frac{3\eta}{5}, \quad r_B - r_A = \frac{\eta}{5} > 0$$

$$l_A = l^* + \frac{\eta}{5}, \quad l_B = l^* + \frac{3\eta}{10}, \quad l_B - l_A = \frac{\eta}{10}.$$

$$Prof_A^5 = \frac{(3\eta)^3}{500\eta} - \kappa, \quad Prof_B^5 = \frac{2(\eta)^3}{125\eta}.$$

The table below summarizes the profits of two banks under all possible scenarios. Then we can determine the Nash equilibria by comparing profits under different strategies.

		Bank B		
		Branch only	Branch + E-banking	E-banking only
	Branch only	$(\frac{\eta^2}{8} - \kappa, \frac{\eta^2}{8} - \kappa)$	$(Prof_A^3, Prof_B^3)$	$(Prof_A^4, Prof_B^4)$
Bank A	Branch + E-banking	$(Prof_B^3, Prof_A^3)$	$(\frac{\eta^2}{8} - \kappa, \frac{\eta^2}{8} - \kappa)$	$(Prof_A^5, Prof_B^5)$
	E-banking only	$(Prof_B^4, Prof_A^4)$	$(Prof_B^5, Prof_A^5)$	$(0, 0)$

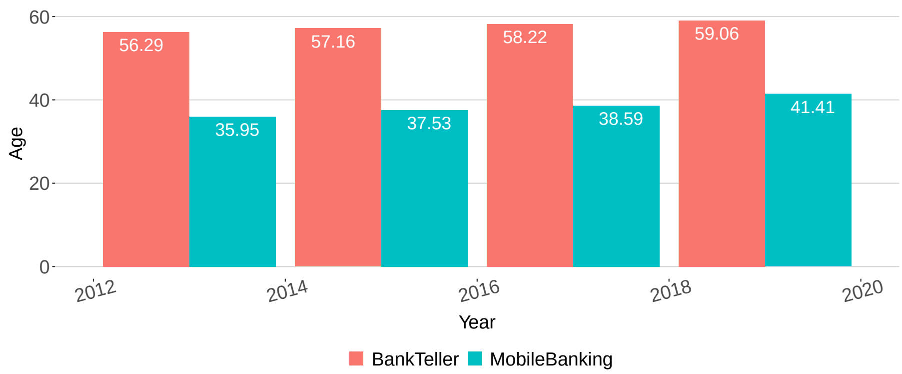
We have $Prof_A^3 < \frac{\eta^2}{8} - \kappa$, $Prof_B^3 > \frac{\eta^2}{8} - \kappa$, $Prof_A^4 < Prof_A^5$, and $Prof_B^4 > Prof_B^5$. Then, we can solve the Nash equilibria when mobile banking option is available.

- If $Prof_B^5 > \frac{\eta^2}{8} - \kappa$, then Case 5 {A: Branch + E-banking, A: E-banking only} and its symmetric case {A: E-banking, A: Branch + E-banking} are Nash equilibria.
- If $Prof_B^5 < \frac{\eta^2}{8} - \kappa$, then Case 2 {A: Branch + E-banking, B: Branch + E-banking} is Nash equilibrium.

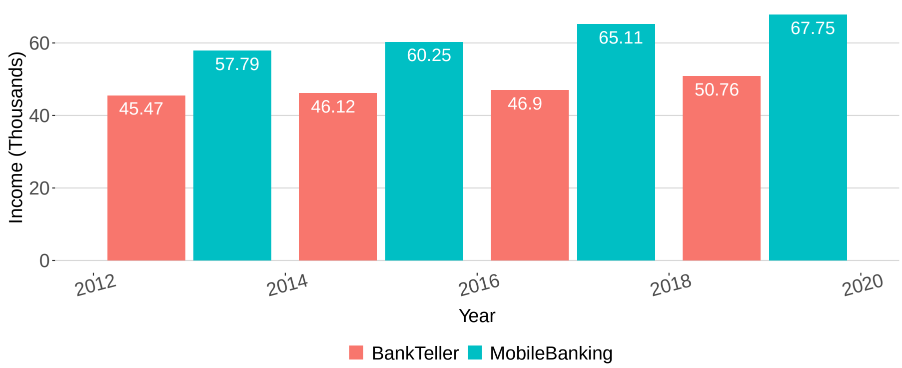
B Figures for Additional Supporting Evidence and Alternative Channels

Figure B.1: Characteristics of Households Using Branches v.s. Mobile Banking

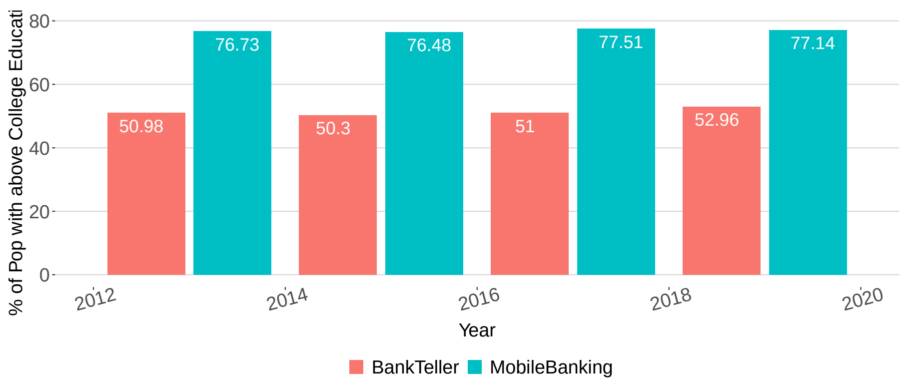
(a) Age



(b) Income



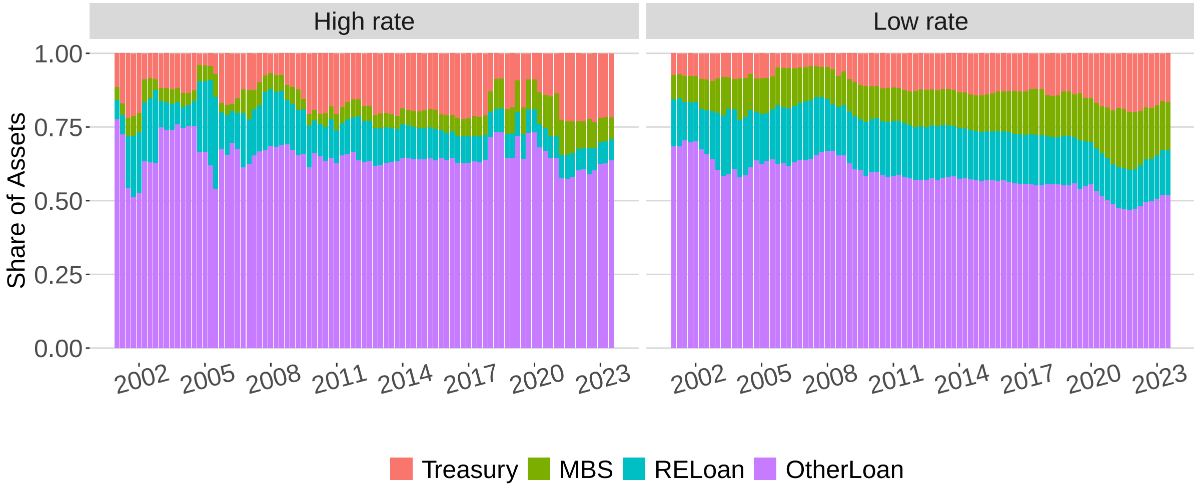
(c) Education



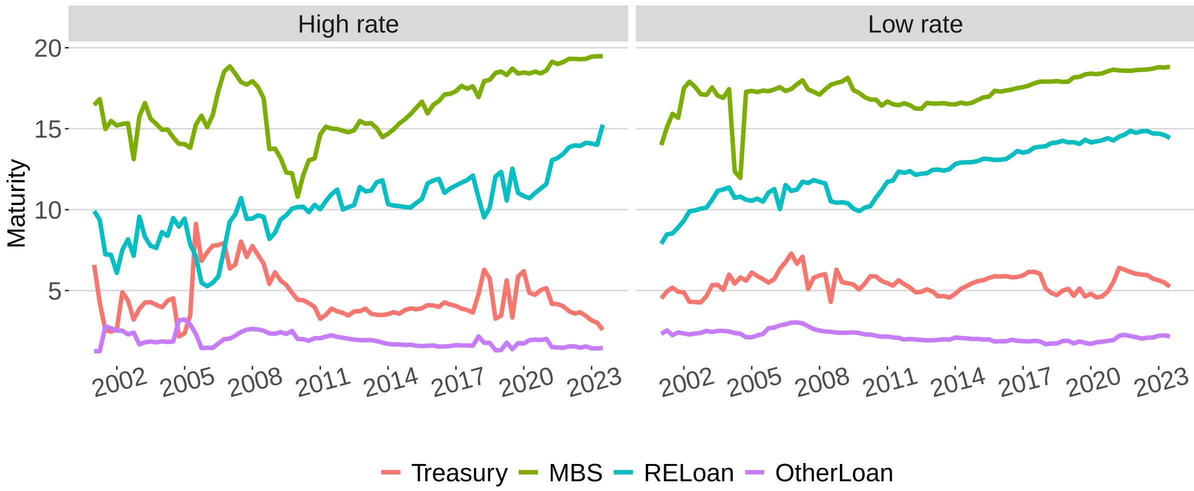
Notes: These figures present the characteristics of households utilizing bank tellers versus mobile banking as their primary means of accessing banking services. The data is derived from the FDIC Survey of Consumer Use of Banking and Financial Services. Respondents were asked to specify their most common method of accessing their accounts, choosing from options such as "Bank teller," "ATM/Kiosk," "Telephone banking," "Online banking," "Mobile banking," and "Other." Panels A, B, and C depict the average age, average income, and the proportion of households with education beyond the college level for households utilizing bank tellers and mobile banking to access banking services over the years.

Figure B.2: Maturity Decomposition

(a) Share of Assets



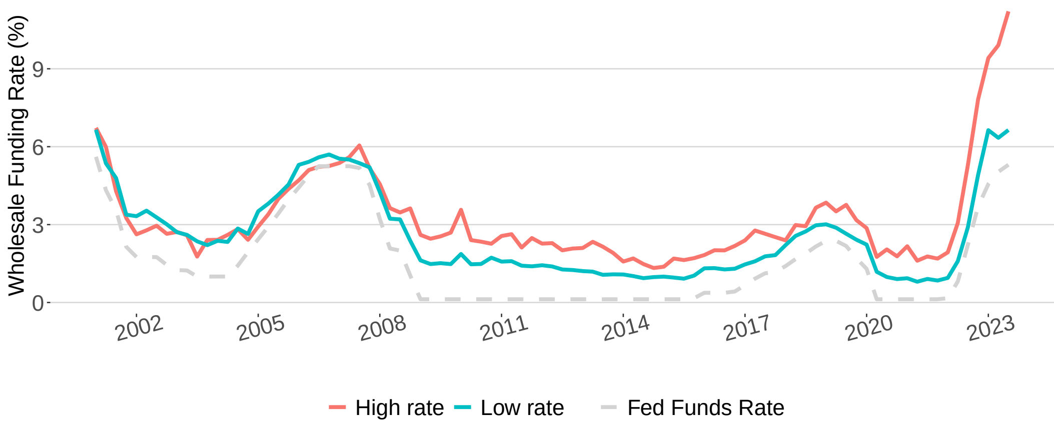
(b) Maturity



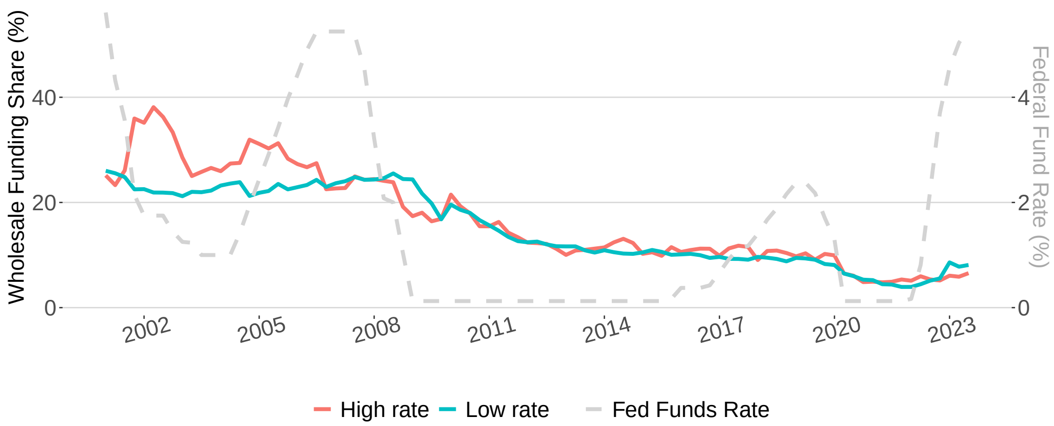
Notes: This figure compares the portfolio characteristics of high and low rate banks among the top 25 banks from 2001Q1 through 2023Q3. Figure B.2a examines the portfolio composition of high rate and low rate banks; share of treasuries (red), mortgage-backed securities (green), real estate loans (blue), and other loans (purple). Figure B.2b examines the maturity (years) of these asset classes for high rate and low rate banks. See Appendix Table C.1 for more details on the construction of key variables. A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MCD10K rate and deposit rate from the Call Report, falls within the top quintile.

Figure B.3: Wholesale Funding

(a) Wholesale Funding Rate



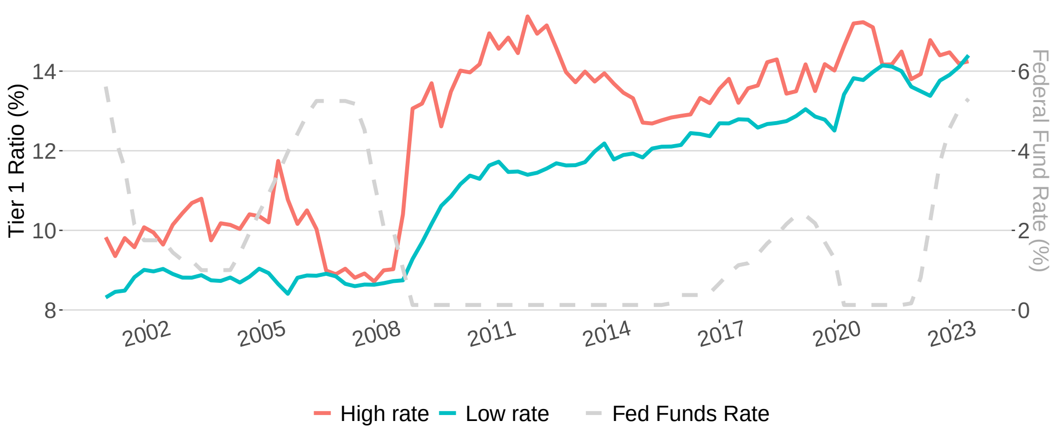
(b) Wholesale Funding Share



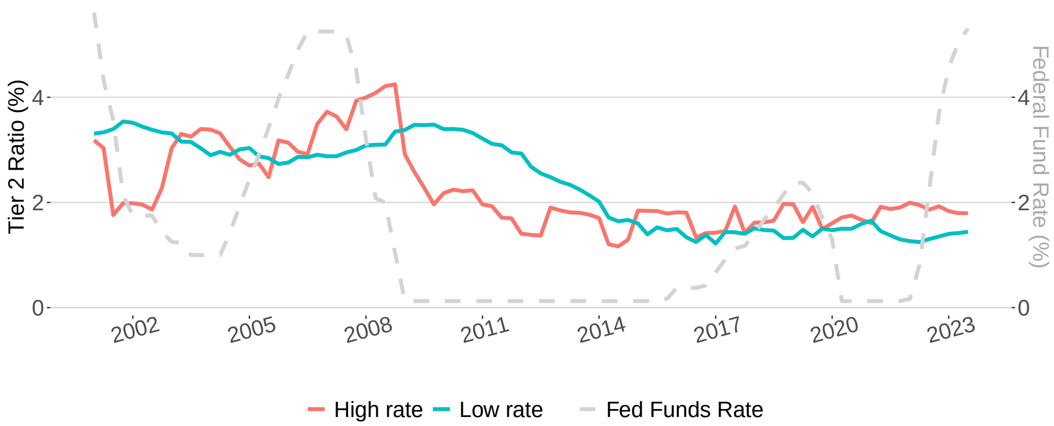
Notes: The figures plot the wholesale funding share (in panel A) and rate (in panel B) of high and low rate banks among the top 25 banks from 2001Q1 through 2023Q2. The wholesale funding includes federal funds purchased and repurchase agreements, subordinated debt, and other borrowed funds. See Appendix Table C.1 for more details on the construction of key variables. A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MDC10K rate and deposit rate from the Call Report, falls within the top quartile.

Figure B.4: Tier 1 and Tier 2 Ratios

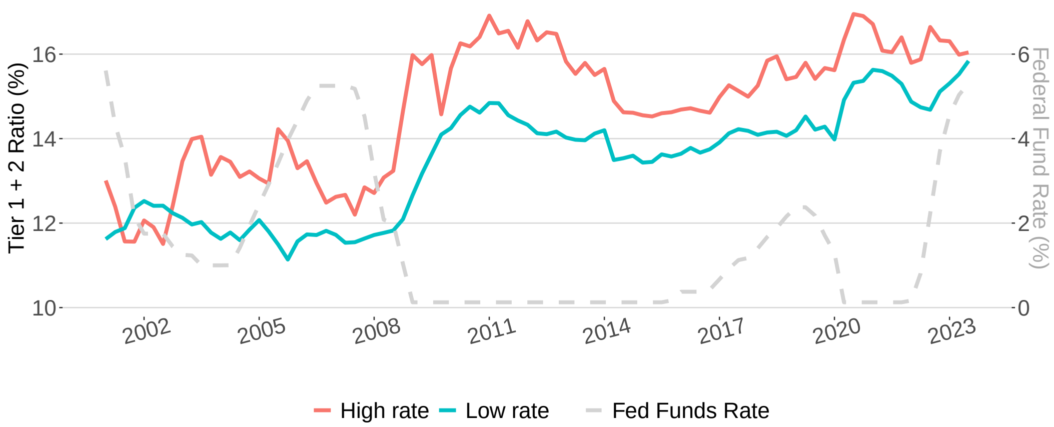
(a) Tier 1 Ratio



(b) Tier 2 Ratio



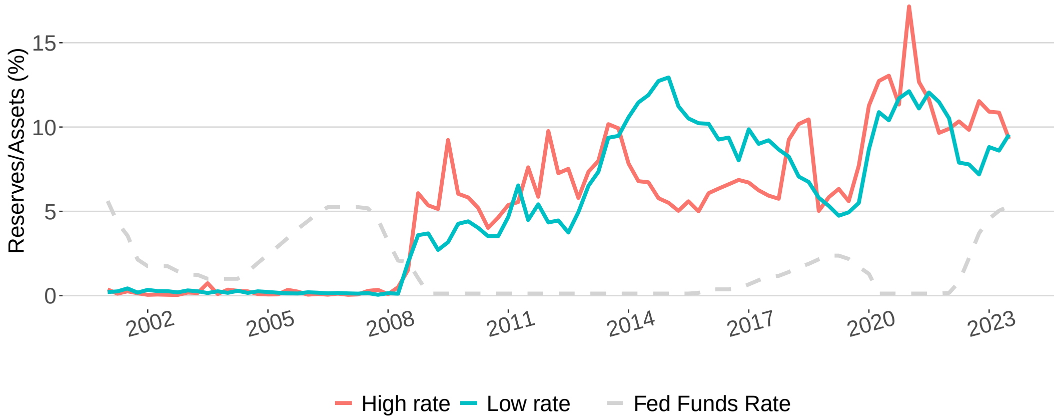
(c) Tier 1+2 Ratio



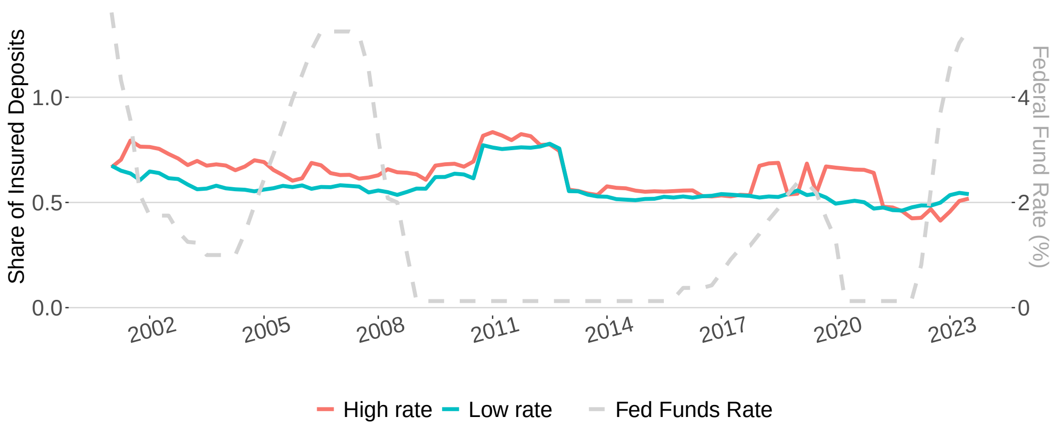
Notes: This figure compares the Tier 1/2 ratio of high and low rate banks among the top 25 banks from 2001Q1 through 2023Q3. See Appendix Table C.1 for more details on the construction of key variables. The left y-axis represents the quarterly average Federal Fund Target rate (FFTar). A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MCD10K rate and deposit rate from the Call Report, falls within the top quintile.

Figure B.5: Reserves

(a) Reserves



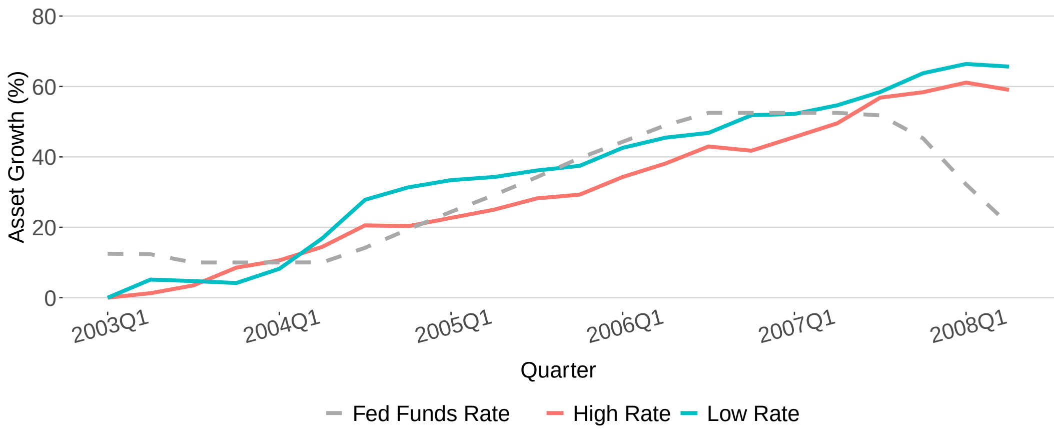
(b) Insured Deposit Share



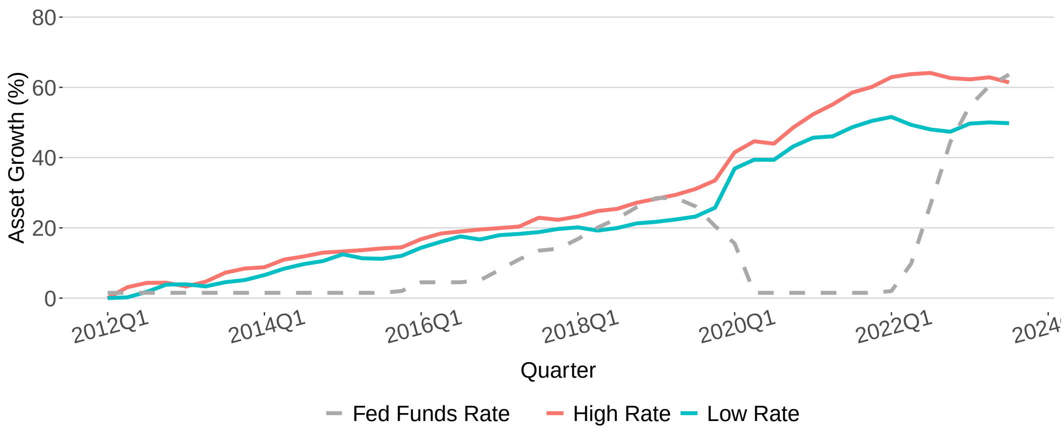
Notes: This figure compares the reserve holding of high and low rate banks among the top 25 banks from 2001Q1 through 2023Q3. See Appendix Table C.1 for more details on the construction of key variables. The left y-axis represents the quarterly average Federal Fund Target rate (FFTar). A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MCD10K rate and deposit rate from the Call Report, falls within the top quintile.

Figure B.6: Asset Growth

(a) 2003Q1-2008Q2



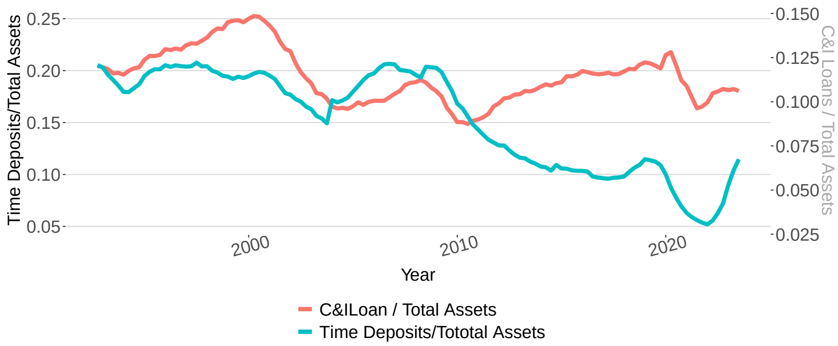
(b) 2012Q1-2023Q3



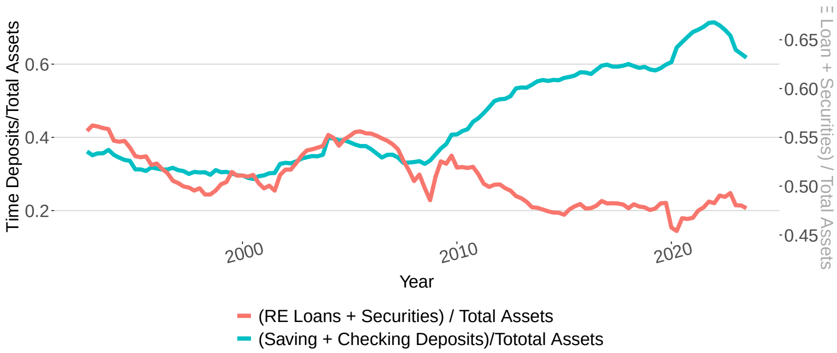
Notes: This figure compares the asset growth of high and low rate banks for top 25 banks. Figure B.6a compares the asset growth experienced by high rate banks to that of low rate banks from 2003Q1 through 2008Q2. Figure B.6b compares the asset growth experienced by high rate banks to that of low rate banks from 2012Q1 through 2023Q3. For ease of comparison, the growth rates of high rate and low rate banks are normalized to 0% in the first quarter, i.e., 2003Q1 and 2012Q1. The left y-axis represents the quarterly average Federal Fund Target rate (Fed Funds Rate). A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MCD10K rate and deposit rate from the Call Report, falls within the top quintile.

Figure B.7: Extension of Figure 1 from Supera (2021) to 2023Q3

(a) C&I Loans vs. Time Deposits



(b) Real Estate Loans and Securities vs. Savings and Checking Deposits



Notes: This figure extends Figure 1 of Supera (2021) to 2023Q3. Panel (a) plots the time-series evolution of C&I loans versus time deposits of all banks, expressed as a share of total assets. Panel (b) plots the time-series evolution of real estate loans and securities versus savings deposits of all banks, also expressed as a share of total assets.

C Additional Tables

Table C.1: Construction of Key Variables

Variable Name	Construction
Rate	
Deposit rate (%)	(edepdom$_q$+edepfor$_q$)/dep$_{q-1}$*100*4
Loan rate (%)	(ilndom$_q$+ilnfor$_q$+ils$_q$)/lnlsgr$_{q-1}$*100*4
Interest income (%)	intinc$_q$/asset$_{q-1}$ * 100 * 4
Interest expense (%)	eintexp$_q$/asset$_{q-1}$ * 100 * 4
NIM rate (%)	nim$_q$/asset$_{q-1}$ * 100 * 4
Composition	
MBS	scpt3les + scpt3t12 + scpt1t3 + scpt3t5 + scpt5t15 + scptov15
Treasury	scnm3les + scnm3t12 + scnm1t3 + scnm3t5 + scnm5t15 + scnmov15
RELoan	lnrs3les + lnrs3t12 + lnrs1t3 + lnrs3t5 + lnrs5t15 + lnrsov15
OtherLoan	lnot3les + lnot3t12 + lnot1t3 + lnot3t5 + lnot5t15 + lnotov15
Maturities	
Maturity$_{MBS}$	(0.15*scpt3les + 0.6*scpt3t12 + 2*scpt1t3 + 4*scpt3t5 + 10*scpt5t15 + 20*scptov15)/MBS
Maturity$_{Treasury}$	(0.15*scnm3les + 0.6*scnm3t12 + 2*scnm1t3 + 4*scnm3t5 + 10*scnm5t15 + 20*scnmov15)/Treasury
Maturity$_{RELoan}$	(0.15*lnrs3les + 0.6*lnrs3t12 + 2*lnrs1t3 + 4*lnrs3t5 + 10*lnrs5t15 + 20*lnrsov15) / RELoan
Maturity$_{OtherLoan}$	(0.15*lnot3les + 0.6*lnot3t12 + 2*lnot1t3 + 4*lnot3t5 + 10*lnot5t15 + 20*lnotov15) / OtherLoan
Maturity	(0.15*(scpt3les + scnm3les + lnrs3les + lnot3les) + 0.6*(scpt3t12 + scnm3t12 + lnrs3t12 + lnot3t12) + 2*(scpt1t3 + scnm1t3 + lnrs1t3 + lnot1t3) + 4*(scpt3t5 + scnm3t5 + lnrs3t5 + lnot3t5) + 10*(scpt5t15 + scnm5t15 + lnrs5t15 + lnot5t15) + 20*(scptov15 + scnmov15 + lnrsov15 + lnotov15)) / (MBS + Treasury + RELoan + OtherLoan)
Short-term Share	
ShortTerm$_{MBS}$	(scpt3les + scpt3t12)/ Maturity
ShortTerm$_{Treasury}$	(scnm3les + scnm3t12)/ Treasury
ShortTerm$_{RELoan}$	(lnrs3les + lnrs3t12)/ RELoan
ShortTerm$_{OtherLoan}$	(lnot3les + lnot3t12)/ OtherLoan
ChargeOffs	
ChargeOff$_{RELoan}$	ntre$_q$/lnre$_{q-1}$*100*4
ChargeOff$_{CILoan}$	ntci$_q$/lnci$_{q-1}$*100*4
ChargeOff$_{IndLoan}$	ntcon$_q$/lncon$_{q-1}$*100*4
ChargeOff$_{Other}$	(ntlnls$_q$-ntre$_q$-ntci$_q$-ntcon$_q$)/(lnls$_{q-1}$-lnre$_{q-1}$-lnci$_{q-1}$-lncon$_{q01}$)*100*4
ChargeOff	ntlnls$_q$/lnls$_{q-1}$*100*4
Liquidity Measures	
Tier 1 Ratio (%)	RBCT1J/RWAJT*100
Tier 2 Ratio (%)	RBCT2/RWAJT*100

Notes: We follow the variable definitions from the FDIC's Statistics on Depository Institutions. See SDI.

Table C.2: Summary Statistics

Panel A: High v.s. Low rate Banks Comparison

	2009-2016		
MCD (%)	0.20	0.05	0.15***
DepRate (%)	0.15	0.02	0.13***
Insured Deposits Share	0.39	0.51	-0.11***
#Branches	849	4039	-3189***
$\log(\frac{\#\text{ Branches}}{\text{Deposits}})$	-0.15	0.86	-1.02***
ΔDeposits (%)	1.00	0.95	0.05
NIM rate (%)	2.58	2.09	0.49***
Maturity (Years)	3.35	5.44	-2.09***
Charge-off Rate (%)	1.52	0.70	0.82***

Panel B: Correlation Matrix of Rates

	DepRate	SAV	CD	MM
DepRate	1.000	0.687	0.922	0.843
SAV	0.687	1.000	0.694	0.766
MCD	0.922	0.694	1.000	0.856
MM25	0.843	0.766	0.856	1.000

Notes: Panel A compares various metrics between high and low rate banks among the top 25 banks between 2009Q1 to 2006Q4. A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MDC10K rate and deposit rate from the Call Report, falls within the top quartile. The averages are reported separately for the two types of banks, as well as their difference. Standard errors are clustered at the quarter-year levels and are accounted for autocorrelation consistent errors using Driscoll-Kraay with 4-quarter lags. *, **, *** represent statistical significance at 10%, 5% and 1% level, respectively. CD refers to the 12-month certificate of deposit rate on accounts with at least $10,000, collected from RateWatch. DepRate is the deposit rate calculated from the Call Reports. The share of insured deposits, NIM rate, quarterly growth of deposits, maturity of loans and securities, charge-offs of loans are extracted from the Call Reports. Additionally, we count the number of branches for each bank using the Statement of Deposits (SOD). Panel B presents the correlation matrix of various measures of the deposit rate. SAV refers to the savings rate and MM refers to the money market account rate on accounts with at least $25,000. Both are recorded by RateWatch.

Table C.3: Variation in Branch Deposit Rates across Largest Banks and BHCs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Time FE	RSSD FE	BHC FE	RSSD+Time FE	BHC+Time FE	RSSD × Time FE	BHC × Time FE
R^2	0.9056	0.0657	0.0674	0.9320	0.9423	0.9423	0.9636
adj. R^2	0.9056	0.0588	0.0669	0.9315	0.9422	0.9363	0.9626
N	916,859	910,276	57,545	910,276	57,545	513,270	57,401

Notes: This table reports the R^2, adj R^2 and number of observations from regressing the 12-month certificate of deposit rate at the Branch × Bank × Quarter-Year level on quarter-year fixed effects (column 1), RSSD fixed effects (column 2), BHC fixed effects (column 3), RSSD and quarter-year fixed effects (column 4), BHC and quarter-year fixed effects (column 5), RSSD × quarter-year fixed effects (column 6), and BHC × quarter-year fixed effects (column 7).

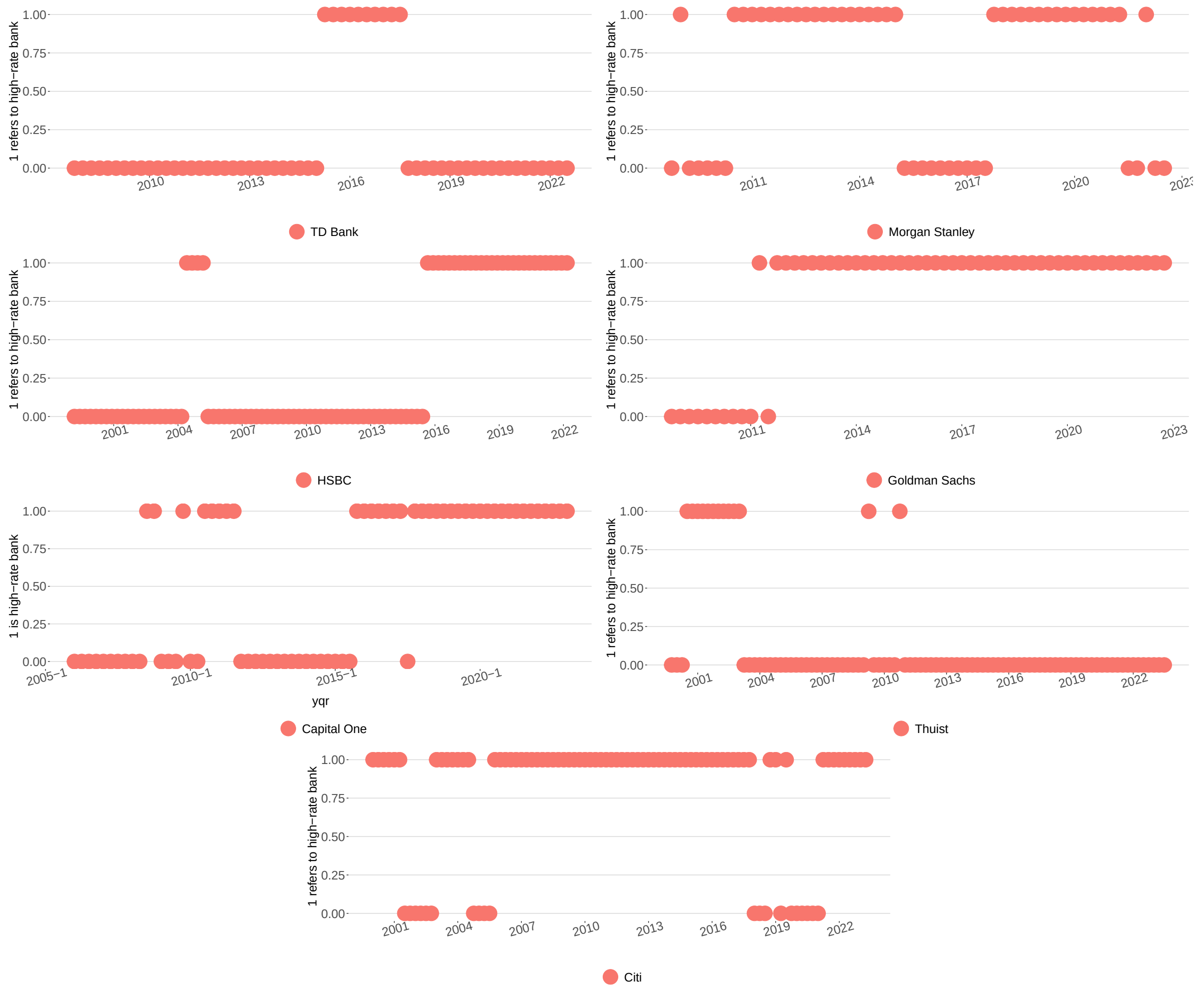
Table C.4: What Predicts the Bank Type?

	$\Pr(\text{High Rate}_{2009-2023})$	$\mathbb{1}(\text{High Rate})_{2009-2023}$
	(1)	(2)
$\log(\frac{\text{Branches}}{\text{Deposit}})_{2001-2008}$	0.091***	0.129***
	(0.034)	(0.044)
Branch-weighted County Average Age$^{2001-2008}$	-0.043**	-0.063***
	(0.017)	(0.021)
$\log(\#\text{Branch})_{2001-2008}$	-0.051**	-0.062*
	(0.025)	(0.033)
Tier $1{+}2_{2001-2008}$	0.001	-0.003
	(0.004)	(0.005)
Reserve $\text{share}_{2001-2008}$	9.838	13.245
	(9.365)	(10.865)
Insured $\text{dep}_{2001-2008}$	0.453**	0.504**
	(0.181)	(0.224)
$\Delta\text{Dep}_{2001-2008}$ (%)	-0.001	-0.003
	(0.002)	(0.003)
$\text{ROA}_{2001-2008}$	0.018	0.030
	(0.022)	(0.034)
Constant	1.867***	2.679***
	(0.642)	(0.796)
Adjusted R^2	0.146	0.133
Observations	129	129

Notes: This table outlines how the characteristics of banks between 2001 and 2008 predict their classification from 2009 to 2023. The dependent variable of column 1 measures the average likelihood of a bank being classified as a high-rate bank after 2009. In column 2, the dependent variable indicates whether there is a greater than 50% likelihood of being classified as such. The independent variables represent the average characteristics of banks between 2001 and 2008. These include the log-normalized branch-to-deposit ratio, the branch-weighted average age of the counties they operate in, the log-normalized number of branches, the Tier 1 and Tier 2 capital ratios, the reserve ratio, the share of insured deposits, the annual deposit growth rate, and the ROA. *, **, *** represent statistical significance at 10%, 5% and 1% level, respectively.

Table C.5: Classification of Banks

High rate banks	American Express, Ally Financial
Low rate banks	Charles Schwab, SVB, M&T Bank, JP Morgan, KeyBank, Huntington, PNC, Fifth Third Bank, BOA, State Street Bank, U.S. Bankcorp, Wells Fargo, Citizens Bank, Northern Trust, Bank of Montreal, Regions Financial, Bank of New York, First Republic Bank



Notes: The table lists banks that maintain a consistent classification throughout the entire sample period. The accompanying figures illustrate the shifts in bank types over the sample period. We present the classification for the top 25 by size in the 2022-2023 period.

Table C.6: Deposit Betas (Robustness Check with Quarter FE)

	ΔDep. Rate	ΔInterest Expense	ΔInterest Income	ΔNIM
	(1)	(2)	(3)	(4)
ΔFFTar$\times\mathbb{1}$(High Rate)$\times$Post	0.504***	0.150***	0.111	-0.028
	(0.114)	(0.039)	(0.068)	(0.049)
ΔFFTar$\times\mathbb{1}$(High Rate)	-0.042	-0.013	-0.032	-0.028
	(0.108)	(0.036)	(0.064)	(0.039)
Controls + Quarter FE	✓	✓	✓	✓
Adjusted R^2	0.185	0.018	0.001	0.001
Observations	1846	2268	2268	2268
Mean of Dep. Variable	-0.020	0.001	-0.009	-0.010

Notes: This table reports the estimated coefficients from the following regression specification:

$$\begin{aligned} Y_{i,q} &= \delta_q + \beta_1 \times \Delta\text{FFTar}_q \times \mathbb{1}_{\text{High Rate},i} \times \text{Post}_q + \beta_2 \times \Delta\text{FFTar}_q \times \mathbb{1}_{\text{High Rate},i} \\ &\quad + \beta_3 \times \Delta\text{FFTar}_q \times \text{Post}_q + \beta_4 \times \Delta\text{FFTar}_q + \beta_5 \times \mathbb{1}_{\text{High Rate},i} \\ &\quad + \beta_6 \times \mathbb{1}_{\text{High Rate},i} \times \text{Post}_q + \beta_7 \times Controls_{i,q-1} + \varepsilon_{i,q} \end{aligned}$$

where i and q indicate the bank and quarter-year, respectively, ΔFFTar_q denotes the change in the Federal Funds Target Rate, $\mathbb{1}_{\text{High Rate}_i}$ denotes whether bank i is a high rate bank, Post_q denotes the post-crisis period (post-2009). Controls include ROA$i, q-1$ and Tier 1$i, q-1$, which represent the return on assets and the tier 1 capital ratio from the previous quarter, respectively. The dependent variable, $Y_{i,q}$ is the change in the 12MCD10K rate in column (1), the change in interest expense (ΔInterest Expense$_{i,q}$) in column (2), change in net interest income (ΔInterest Income$_{i,q}$) in column (3), and change in NIM ($\Delta\text{NIM}_{i,q}$) in column (4). The 12MCD10K rate comes from RateWatch. The change in the loan rate, interest expense, interest income and NIM are computed from the Call Reports. All dependent variables are winsorized at the 0.5% and the 99.5% levels. See Table C.1 for more details on the construction of key variables. A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MDC10K rate and deposit rate from the Call Report, falls within the top quartile. Each observation is weighted by its asset size in the previous quarter. Standard errors (in parentheses) are clustered at the quarter-year levels and are accounted for autocorrelation consistent errors using Driscoll-Kraay with 4-quarter lags. *, **, *** represent statistical significance at 10%, 5% and 1% level, respectively.

Table C.7: Reallocation of Lending During Monetary Policy Cycles (With Additional Controls)

	ΔPersonal Loan$_{i,y}$		ΔC&I Loan$_{i,y}$		ΔRE Loan$_{i,y}$		ΔMBS$_{i,y}$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ΔFed Funds$_y \times$ $\mathbb{1}$(High Rate)$\times$Post	4.666*	5.364**	5.174**	3.286	-0.192	0.154	-18.534**	-16.824**
	(2.559)	(2.542)	(2.356)	(2.386)	(2.269)	(2.462)	(7.526)	(7.347)
ΔFFTar$_y$ $\times$ $\mathbb{1}$(High Rate)	-3.463	-3.934*	-3.358**	-1.352	0.061	-0.087	21.345***	19.565***
	(2.109)	(2.175)	(1.666)	(1.792)	(1.658)	(1.623)	(7.451)	(7.242)
ΔFFTar$_y$	0.802		1.592		2.222***		-5.502***	
	(0.747)		(1.859)		(0.764)		(2.080)	
ΔFFTar$_y \times$Post	-0.044		-1.868		-1.467		0.966	
	(1.021)		(2.059)		(1.424)		(2.101)	
ΔSavDep$_{i,q-1}$	0.183***	0.187***	0.121***	0.143***	0.250***	0.253***	0.119***	0.115***
	(0.033)	(0.030)	(0.041)	(0.040)	(0.051)	(0.054)	(0.035)	(0.038)
ΔTimeDep$_{i,q-1}$	0.064**	0.093***	0.104***	0.067**	0.107***	0.071***	0.072***	0.056***
	(0.026)	(0.025)	(0.034)	(0.031)	(0.030)	(0.021)	(0.016)	(0.019)
ΔDemandDep$_{i,q-1}$	0.057**	0.071***	0.061**	0.089***	0.113***	0.115***	0.080***	0.073***
	(0.027)	(0.026)	(0.025)	(0.022)	(0.021)	(0.022)	(0.019)	(0.020)
Controls	✓	✓	✓	✓	✓	✓	✓	✓
Quarter FE		✓		✓		✓		✓
Adjusted R^2	0.146	0.143	0.199	0.182	0.355	0.266	0.140	0.077
Observations	2165	2165	2135	2135	2137	2137	2119	2119
Mean of Dep. Variable	6.442	6.442	5.780	5.780	5.629	5.629	9.181	9.181

Notes: This table reports the estimated coefficients from the following regression specification:

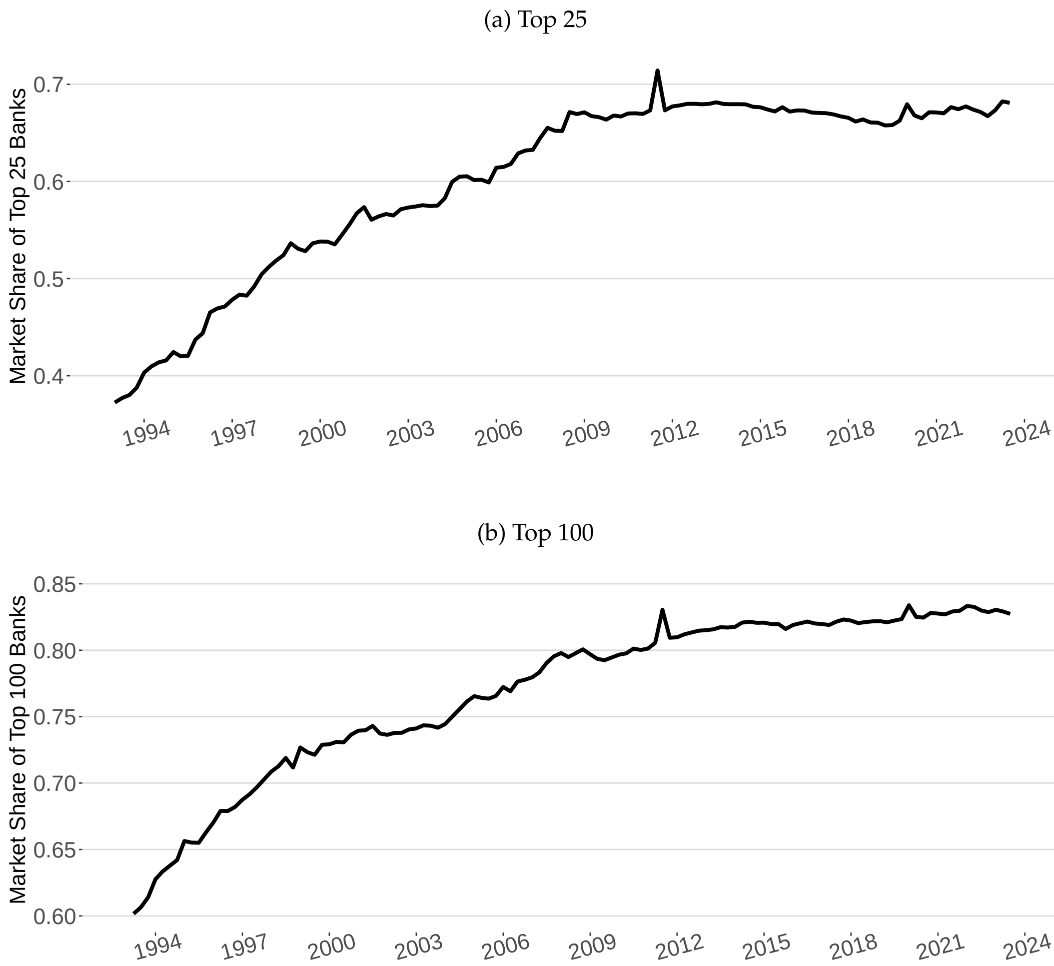
$$\Delta Y_{i,y} = \alpha + \beta_1 \times \Delta\text{Fed Funds Rate}_y \times \mathbb{1}_{\text{High rate},i} \times \text{Post}_q + \beta_2 \times \Delta\text{Fed Funds Rate}_y \times \mathbb{1}_{\text{High rate},i} +$$
$$\beta_3 \times \Delta\text{Fed Funds Rate}_y \times \text{Post}_q + \beta_4 \times \Delta\text{Fed Funds Rate}_y + \beta_5 \times \mathbb{1}_{\text{High rate},i} + \beta_6 \times \mathbb{1}_{\text{High rate},i} \times \text{Post}_q$$
$$\beta_7 \times \Delta\text{Fed Funds Rate}_y \times \mathbb{1}_{\text{High rate},i} \times \text{Crisis} + \beta_8 \times Controls_{i,q-1} + \varepsilon_{i,q},$$

where i and q indicate the bank and quarter-year, respectively, ΔFed Funds Rate$_y$ denotes the one-year change in the Federal Funds Target Rate, $\mathbb{1}_{\text{High rate}_i}$ denotes whether bank i is a high rate bank, Post$_q$ denotes the post-2009 period, Crisis is an indicator for the third and fourth quarters of 2008. Controls include ROA$i, q-1$ and Tier $1i, q-1$, which represent the return on assets and the tier 1 capital ratio from the previous quarter, respectively. Additionally, to account for the channel described by Supera (2021), we include the logarithmic changes in savings deposits, time deposits, and demand deposits from the previous quarter as controls in our analysis. The dependent variable, $\Delta Y_{i,y}$ is the one-year growth of the total deposit, loans to individuals, C&I loans, treasury securities and MBS of bank i, and are winsorized at the 0.5% and the 99.5% levels. A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MCD10K rate and deposit rate from the Call Report, falls within the top quintile. Each observation is weighted by its asset size in the previous quarter. Standard errors (in parentheses) are clustered at the quarter-year levels and are accounted for autocorrelation consistent errors using Driscoll-Kraay with 4-quarter lags. *, **, *** represent statistical significance at 10%, 5% and 1% level, respectively.

Appendix for Online Publication

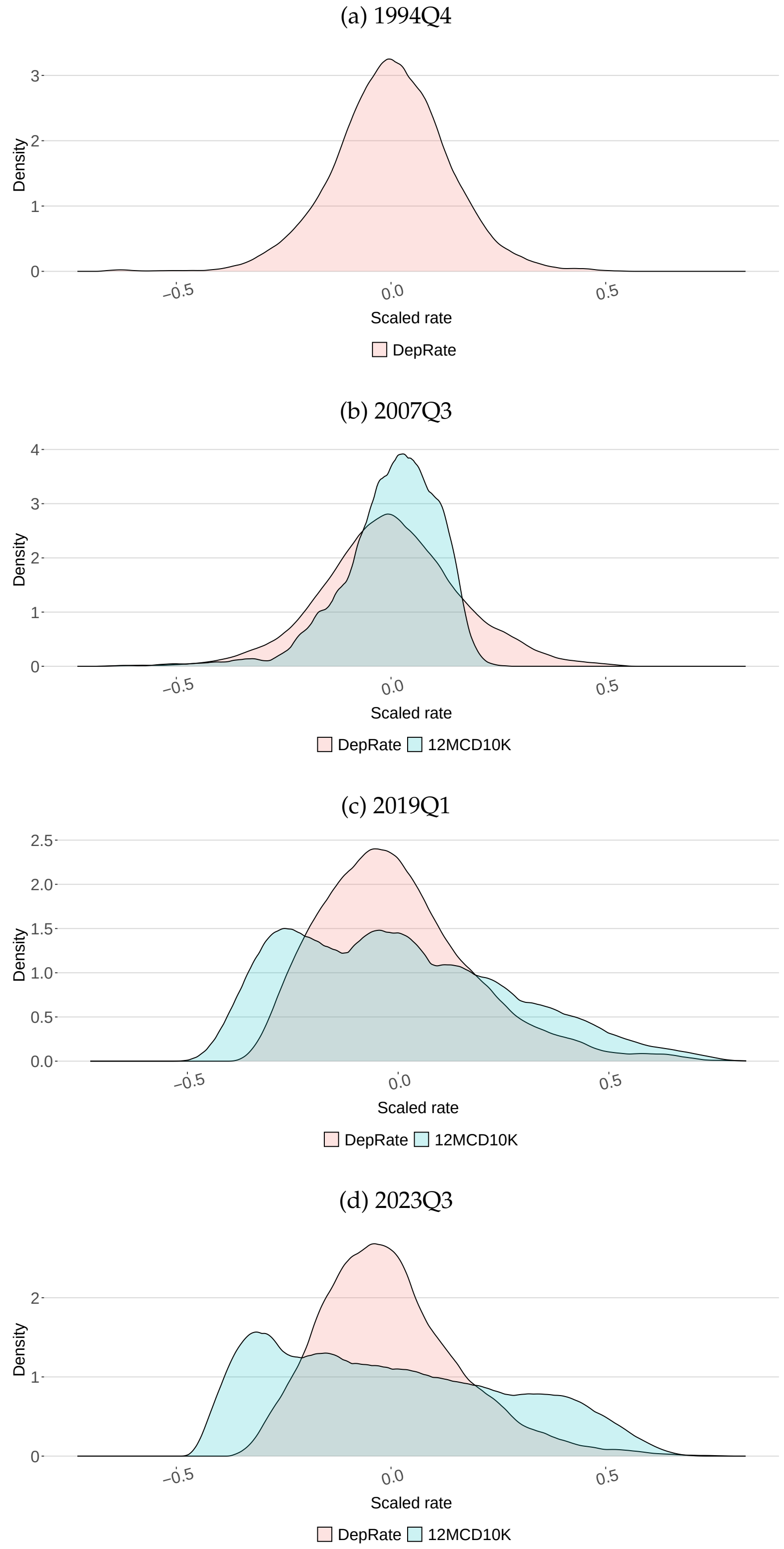
D Additional Robustness Figures and Tables

Figure D.1: Market Share of Top Banks



Notes: This figure presents the market share of the top 25 banks (in panel a) and top 100 banks (in panel b) from 2001Q1 through 2023Q2. Market share is measured by total assets. The top 25 (top 100) banks are defined according to bank size in each quarter. The data used to construct this figure comes from the Call Reports.

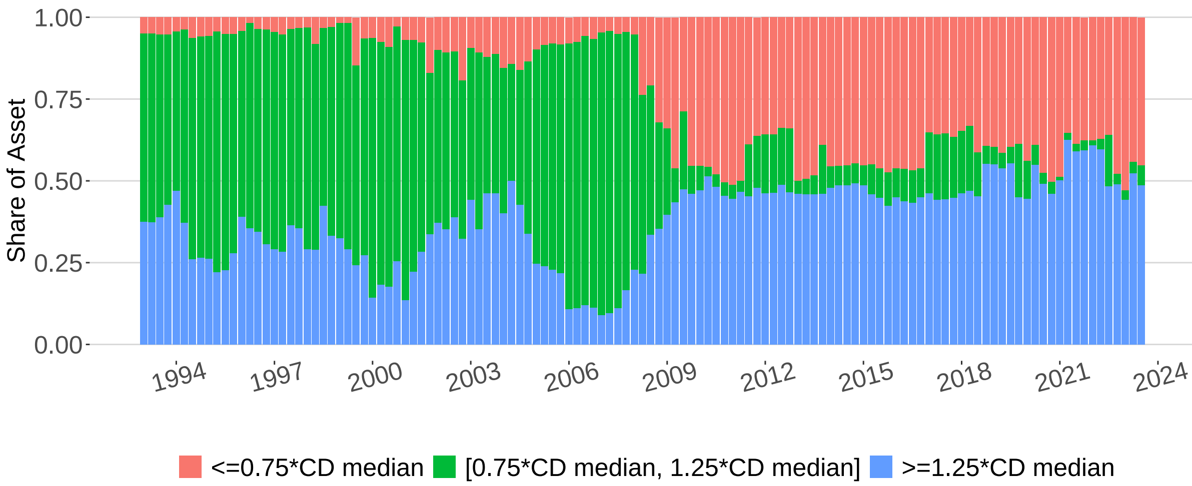
Figure D.2: Dispersion of Deposit Rates for All Banks



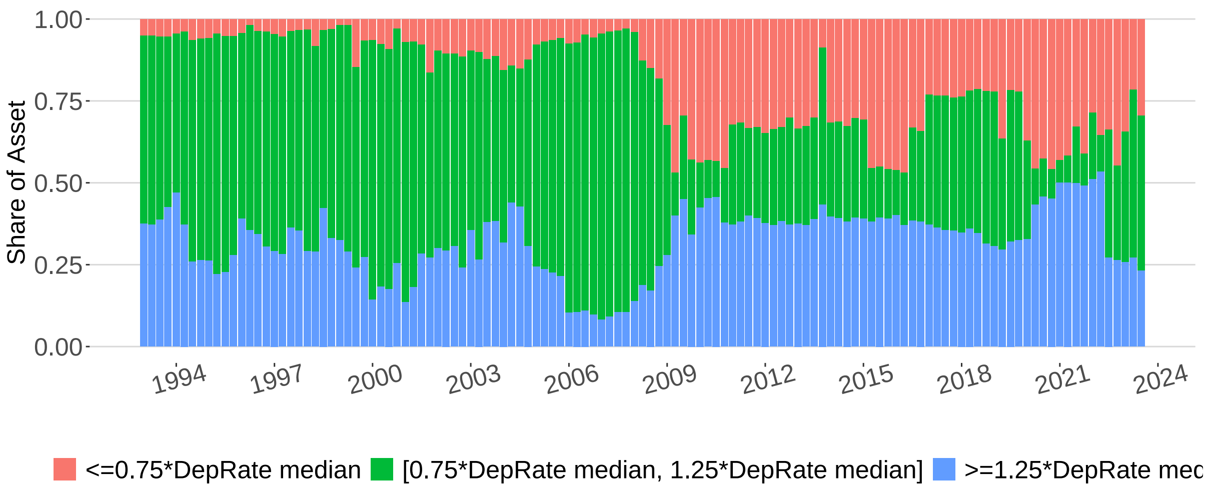
Notes: This figure presents kernel density plots of the scaled and demeaned 12-month certificate of deposit rates of at least $10,000 (12MCD10K) and the scaled and demeaned deposit rates (DepRate) calculated from Call Reports offered by all banks at the peak of each rate hiking cycle. Figures a, b, c and d present the kernel density in 1994Q4, 2007Q3, 2019Q1, and 2023Q3, respectively. The scaled and demeaned 12MCD10K rates (DepRate) are calculated by first scaling the 12MCD10K rates (DepRate) by the Market Yield on U.S. Treasury Securities at 1-Year Constant Maturity (DGS1 series in FRED) and then demeaning the scaled rates.

Figure D.3: Asset Distribution of All Banks

(a) Classification based on 12MCD10K



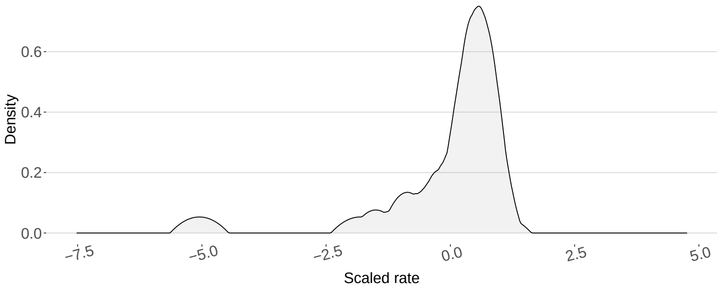
(b) Classification based on DepRate



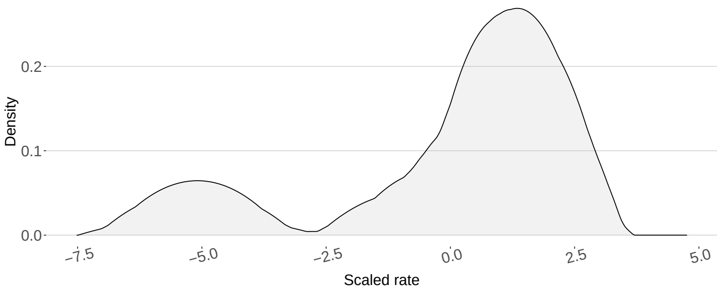
Notes: This figure illustrates the distribution of bank assets among three categories for all banks: banks with deposit rates below 0.75 times the sample median, banks with deposit rates within the range of 0.75 times to 1.25 times the sample median, and banks with deposit rates exceeding 1.25 times the sample median. Panel a and b present asset distribution classified based on 12-month certificate of deposit rates of at least $10,000 (12MCD10K) and deposit rates (DepRate) calculated from Call Reports. If the 12MCD10K bank rate is unavailable, the classification is determined based on DepRate in Panel a. To maintain comparability with Appendix Figure D.2, the sample median is calculated as the median rate of the top 25 banks within each quarter.

Figure D.4: Dispersion of Branch/Deposits Ratio for Top 25 Banks

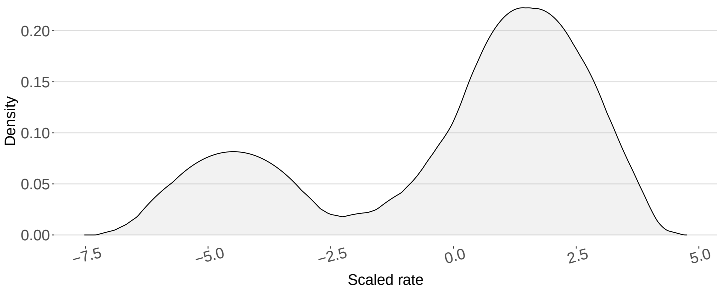
(a) 1994Q4



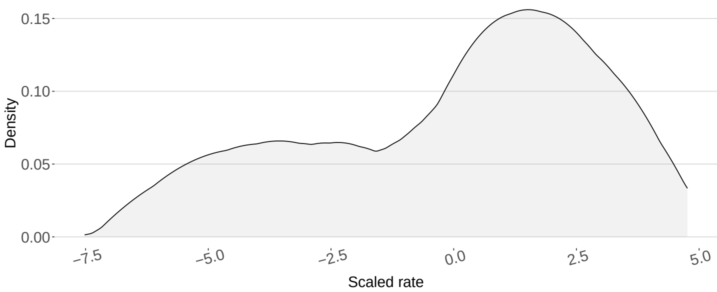
(b) 2007Q3



(c) 2019Q1

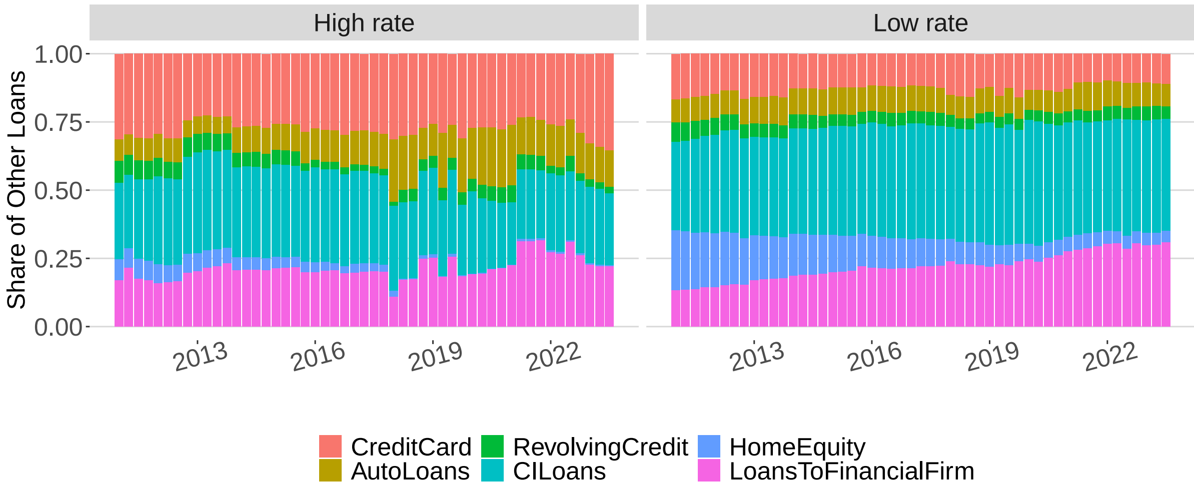


(d) 2022Q2



Notes: This figure displays kernel density plots of the demeaned logarithm of branch deposits by the top 25 banks at the peak of each interest rate hiking cycle. Figures a, b, c and d illustrate the kernel density at the following quarters: 1994Q4, 2007Q3, 2019Q1, and 2022Q2 (the last quarter available in SOD database), respectively. The top 25 banks are determined based on bank size at the beginning of each quarter.

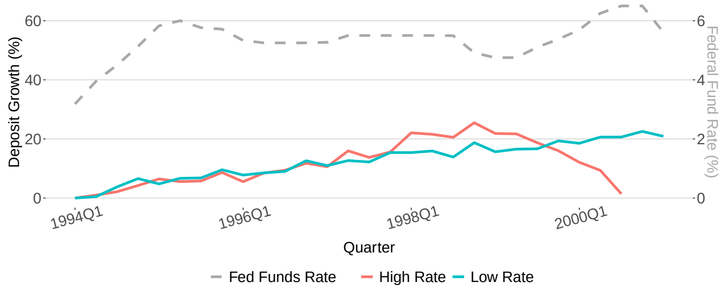
Figure D.5: Share of Non-Real Estate Loans (Top 25 Banks)



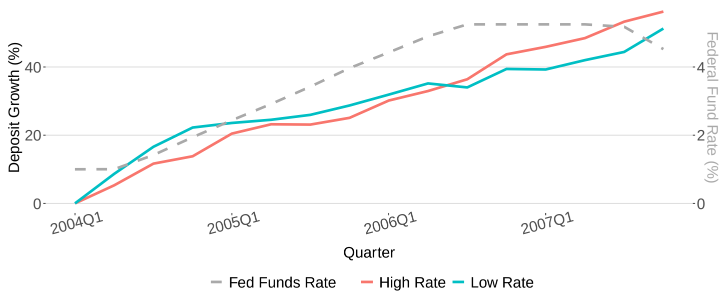
Notes: This figure presents the share of non-real estate loans of high and low rate banks among the top 25 banks from 2001Q1 through 2023Q2. We consider six categories: credit card loans, auto loans, home equity loans, revolving credit to individuals, commercial and industrial loans, and loans to other financial firms. See Appendix Table C.1 for more details on the construction of key variables. A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MDC10K rate and deposit rate from the Call Report, falls within the top quintile.

Figure D.6: Deposit Growth (Fixed Top 25 Banks)

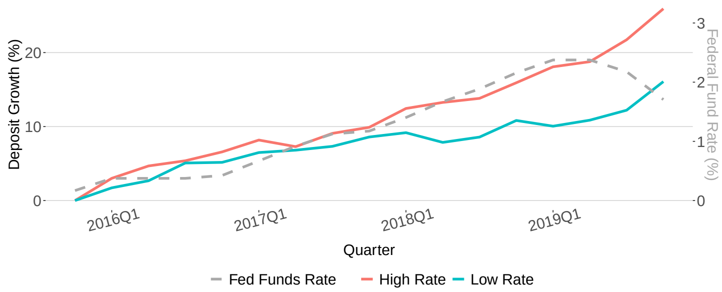
(a) 1993Q4-2001Q1



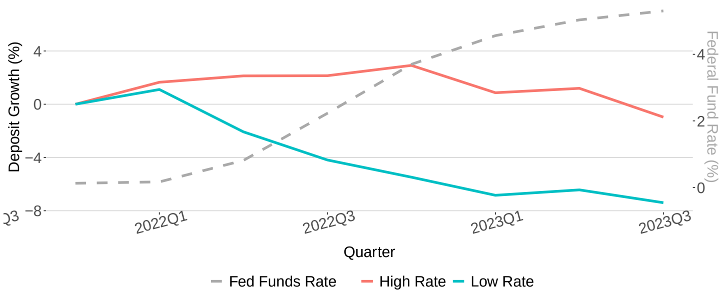
(b) 2004Q1-2007Q4



(c) 2015Q4-2019Q4

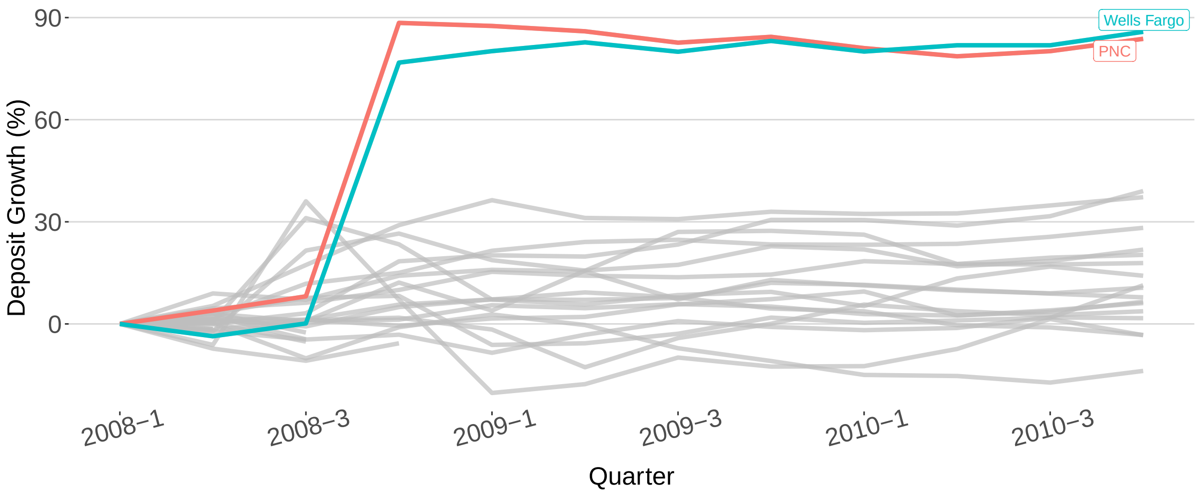


(d) 2021Q4-2023Q2



Notes: This figure compares the deposit growth of high and low rate banks among the top 25 banks over the four recent rate hiking cycles. The difference from Figure 12 is that in this exercise we fix the top 25 banks at the beginning of the cycle. Figures D.6a D.6b, D.6c, and D.6d compare the deposit growth experienced by high-rate banks to that of low-rate banks from 1993Q4 through 2001Q1, from 2004Q1 through 2007Q4, from 2015Q4 through 2019Q4, and from 2021Q4 through 2023Q2, respectively. To facilitate comparison, the growth rates of high-rate and low-rate banks are normalized to 0% in the first quarter of each rate hiking cycle, i.e. 2004Q1, 2015Q4, and 2021Q4. To mitigate the impact of large mergers and acquisitions (M&As) or outliers, we exclude BHC-quarter observations when the change in log deposits exceeds 50%. In total, 15 observations are excluded in 1993Q4-2001Q1 (panel a). The left y-axis represents the quarterly average Federal Fund Target rate (FFTar). A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MDC10K rate and deposit rate from the Call Report, falls within the top quintile.

Figure D.7: Deposit Growth in Crisis Period: 2008Q1-2010Q4



Notes: The figure illustrates the deposit growth of the top 25 banks from 2008Q1 to 2010Q4. The top 25 banks are chosen by their end-of-quarter assets for 2007Q4. The two big jumps in deposit growth are due to M&A: Wells Fargo acquired Wachovia on October 3, 2008, and PNC acquired National City Bank on October 24, 2008. There were many other M&A around the same period, but the effect on deposit growth was relatively small.

Table D.1: Bank Branches with Bank FE

	log(# Branches)		$\log(\frac{\text{Branches}}{\text{Deposit}})$		Branch-weighted County Average Age	
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}$(High Rate)×Post	-1.031***	-0.145**	-0.347	0.055	-0.215*	0.180***
	(0.224)	(0.066)	(0.245)	(0.066)	(0.109)	(0.048)
$\mathbb{1}$(High Rate)	-1.168***	0.127**	-0.838***	-0.036	-0.151*	-0.061*
	(0.161)	(0.051)	(0.229)	(0.064)	(0.085)	(0.036)
$\text{ROA}_{i,q-1}$	-0.271***	0.012	-0.202***	0.014	-0.257***	-0.007
	(0.053)	(0.013)	(0.054)	(0.011)	(0.049)	(0.015)
$\text{Tier1}_{i,q-1}$	0.729***	-0.012	-0.031	0.038	-0.056	-0.149***
	(0.078)	(0.035)	(0.043)	(0.031)	(0.041)	(0.039)
Quarter FE	✓	✓	✓	✓	✓	✓
Bank FE		✓		✓		✓
Adjusted R^2	0.231	-0.025	0.080	-0.026	0.041	-0.011
Observations	8145	8135	8145	8135	7226	7217
Mean of Dep. Variable	6.589	6.589	0.880	0.880	38.603	38.603

Notes: This table reports the estimated coefficients from the following regression specification:

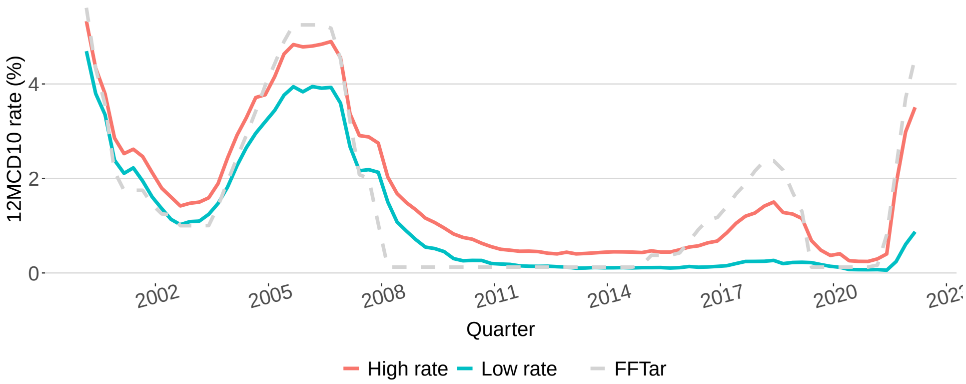
$$Y_{i,q} = \delta_i + \delta_q + \beta_1 \times \mathbb{1}_{\text{High rate},i} \times \text{Post}_q + \beta_2 \times \mathbb{1}_{\text{High rate},i} + \beta_3 \times Controls_{i,q-1} + \varepsilon_{i,q},$$

where i and q indicate the bank and quarter-year, respectively, $\mathbb{1}_{\text{High rate}_i}$ denotes whether bank i is a high rate bank, $Post_t$ denotes the post-crisis period (post-2009). Controls include ROA$i, q-1$ and Tier 1$i, q-1$, which represent the return on assets and the tier 1 capital ratio from the previous quarter, respectively. The dependent variable, $Y_{i,q}$ is the log-transformed number of branches (log(# of Branches)) in columns (1)-(2), the log-transformed ratio of branches to deposits in billions ($\log(\frac{Branches}{Deposit})$) in columns (3)-(4), and the average customer age in columns (5)-(6). The branch-weighted county average age is calculated as the county average age, which is weighted based on the number of branches in each county. The variable $\log(\frac{Branches}{Deposit})$ is winsorized at the 0.5% and the 99.5% levels. Branch and deposit data comes from the FDIC Summary of Deposits. A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MCD10K rate and deposit rate from the Call Report, falls within the top quartile. Each observation is weighted by its asset size in the previous quarter. Standard errors (in parentheses) are clustered at the quarter-year levels and are accounted for autocorrelation consistent errors using Driscoll-Kraay with 4-quarter lags. *, **, *** represent statistical significance at 10%, 5% and 1% level, respectively.

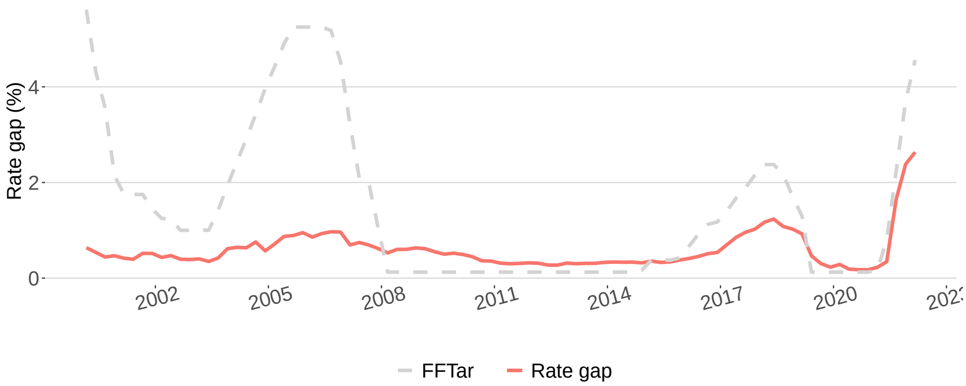
E Robustness Figures and Tables for Top 100 Banks

Figure E.1: Dispersion of Bank Deposit Rates (Top 100 Banks)

(a) Rate



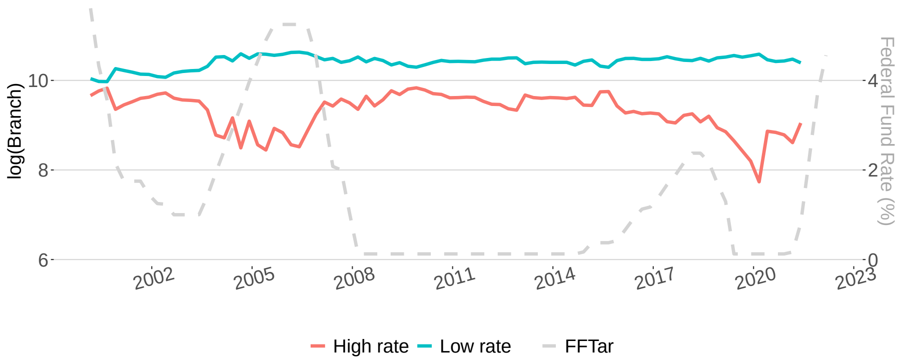
(b) Rate Gap



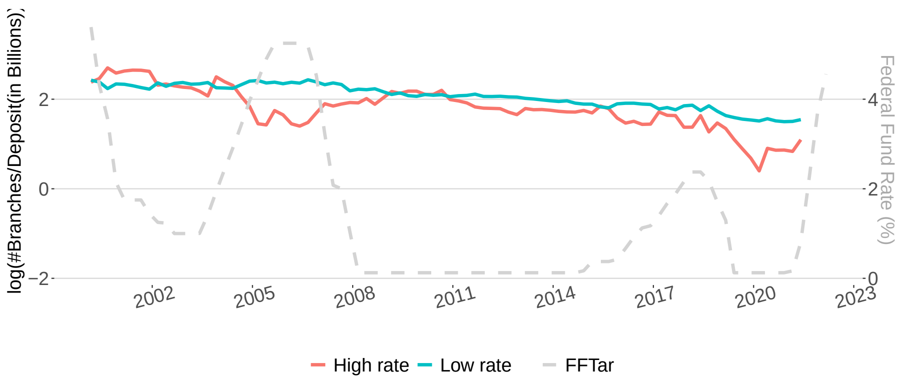
Notes: This figure characterizes the dispersion of deposit rates of high and low rate banks from 2001Q1 through 2023Q2 among the top 100 banks. Figure E.1a presents a time-series plot of the of 12-month certificate of deposit rates of at least $10,000 (12MCD10K) using RateWatch data for *high rate* (blue) and *low rate* (red) banks. Figure E.1b presents the gap in the 12MCD10K rates between high rate and low rate banks. Figure 3c presents the 12MCD10K rate by bank. A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MDC10K rate and deposit rate from the Call Report, falls within the top quartile.

Figure E.2: Branches (Top 100 Banks)

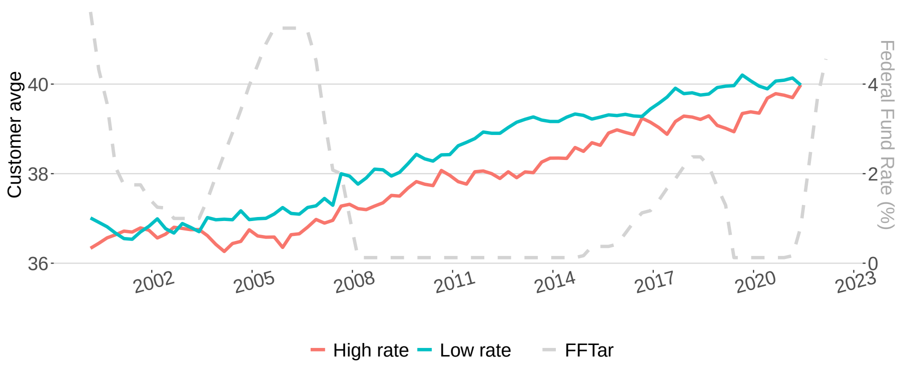
(a) Growth of Branches



(b) $\log \frac{\#Branches}{Deposits}$



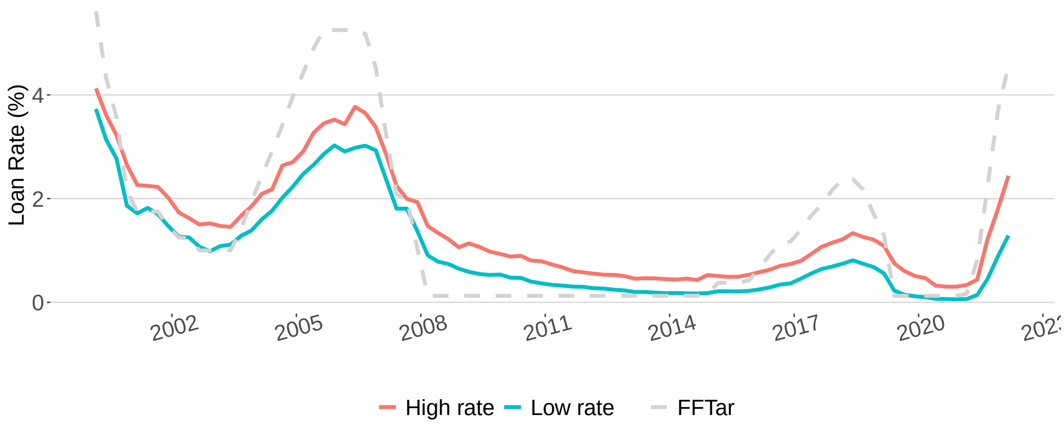
(c) Customer age



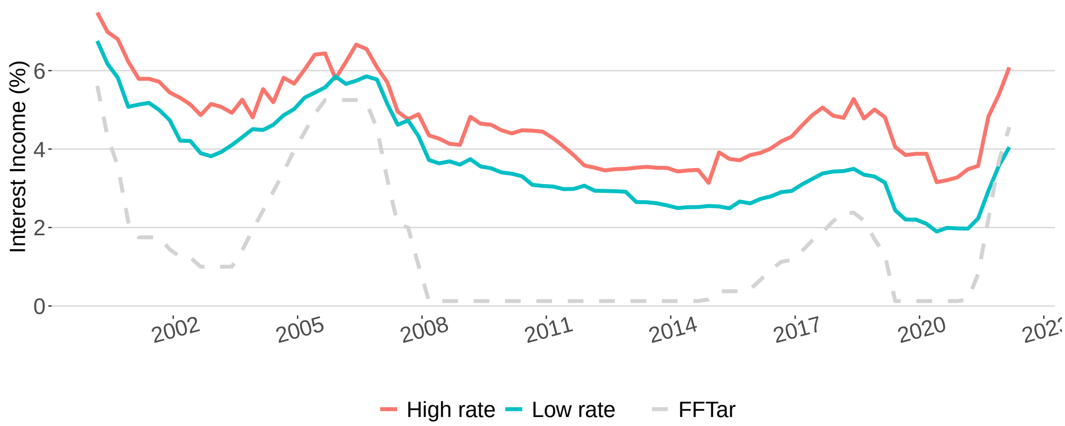
Notes: This figure compares branches operating by high and low rate banks among the top 100 banks from 2001Q1 through 2022Q2, which is the quarter where the most recent SOD data ends. Figure E.2a presents the log-transformed number of branches of high and low rate banks. Figure E.2b presents the log-transformed ratio between branches and deposits (in Billions) of high and low rate banks. Figure E.2c presents the average customer age of high and low rate banks. The average customer age of the bank is calculated as the county average age, which is weighted based on the number of branches in each county. The left y-axis represents the quarterly average Federal Fund Target rate (FFTar). A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MDC10K rate and deposit rate from the Call Report, falls within the top quartile.

Figure E.3: Net Interest Margin (Top 100 Banks)

(a) Interest Expense



(b) Interest Income

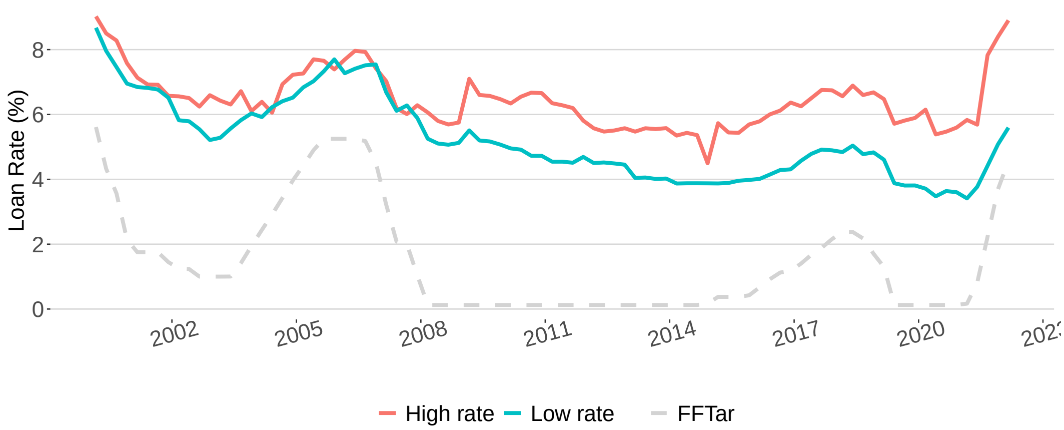


(c) NIM

Notes: This figure compares the interest expense, interest income, and net interest margin of high and low rate banks among the top 100 banks from 2001Q1 through 2023Q2. Figure E.3a presents the interest expense (%) of high and low rate banks. Figure E.3b presents the interest income (%) of high and low rate banks. Figure E.3c presents the net interest margin (NIM) rate (%) for high and low rate banks. See Appendix Table C.1 for more details on the construction of key variables. The left y-axis represents the quarterly average Federal Fund Target rate (FFTar). A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MDC10K rate and deposit rate from the Call Report, falls within the top quartile.

Figure E.4: Credit Risk (Top 100 Banks)

(a) Loan rate



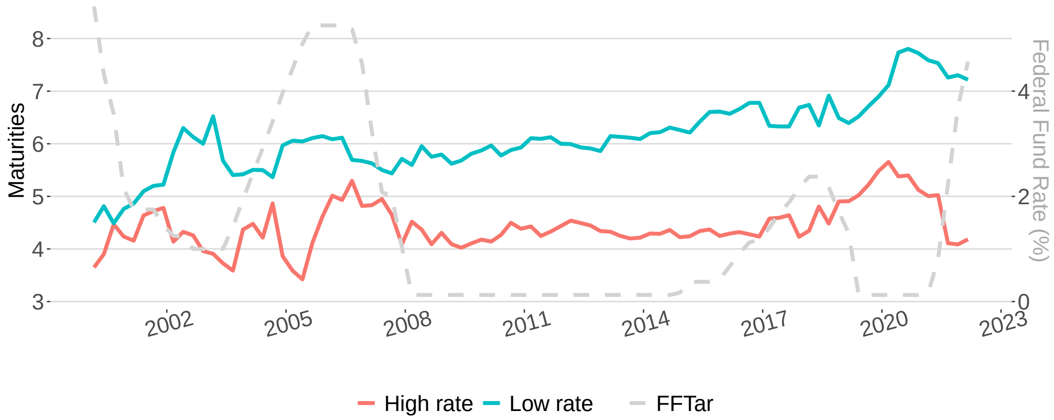
(b) Credit spread

(c) Charge-offs

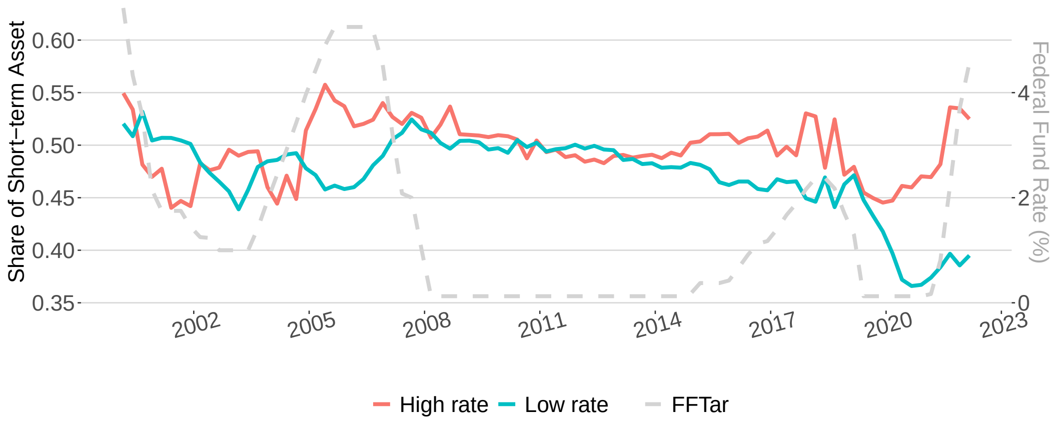
Notes: This figure compares the credit risk of high and low rate banks among the top 100 banks from 2001Q1 through 2023Q2. Figure E.4a presents the loan rate (%) of high and low rate banks. Figure E.4b presents the credit spread (%) of high and low rate banks. The credit spread is computed as the difference between the loan rate and synthetic term rate (average of term treasury yields, weighted by the share of loans with corresponding maturities). Figure E.4c presents the charge-off rate (%) for high and low rate banks. See Appendix Table C.1 for more details on the construction of key variables. The left y-axis represents the quarterly average Federal Fund Target rate (FFTar). A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MDC10K rate and deposit rate from the Call Report, falls within the top quartile.

Figure E.5: Maturity Risk (Top 100 Banks)

(a) Maturity



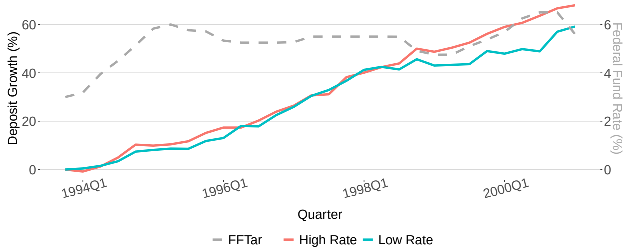
(b) Share of Short-Term Assets



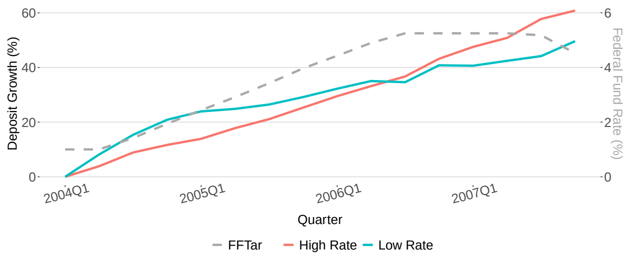
Notes: This figure compares the maturity risk of high and low rate banks among the top 100 banks from 2001Q1 through 2023Q2. Figure E.5a presents the maturity (# of years) of high and low rate banks. Figure E.5b presents the share of assets with less-than one-year maturity (short-term assets) for high and low rate banks. The left y-axis represents the quarterly average Federal Fund Target rate (FFTar). A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MDC10K rate and deposit rate from the Call Report, falls within the top quartile.

Figure E.6: Deposit Growth (Top 100 Banks)

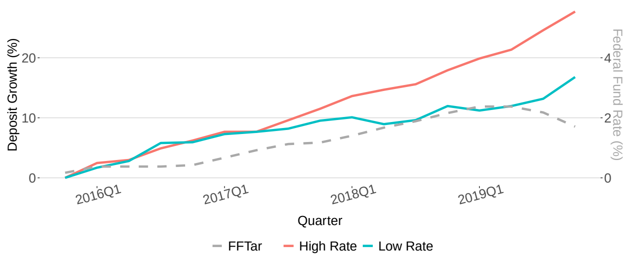
(a) 1993Q4-2001Q1



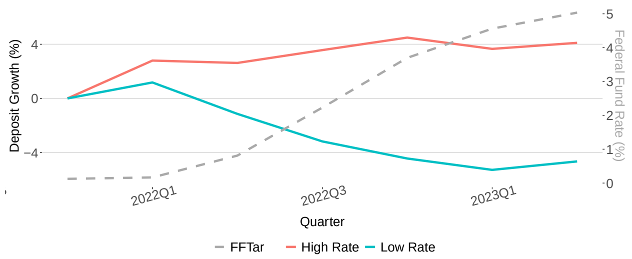
(b) 2004Q1-2007Q4



(c) 2015Q4-2019Q4



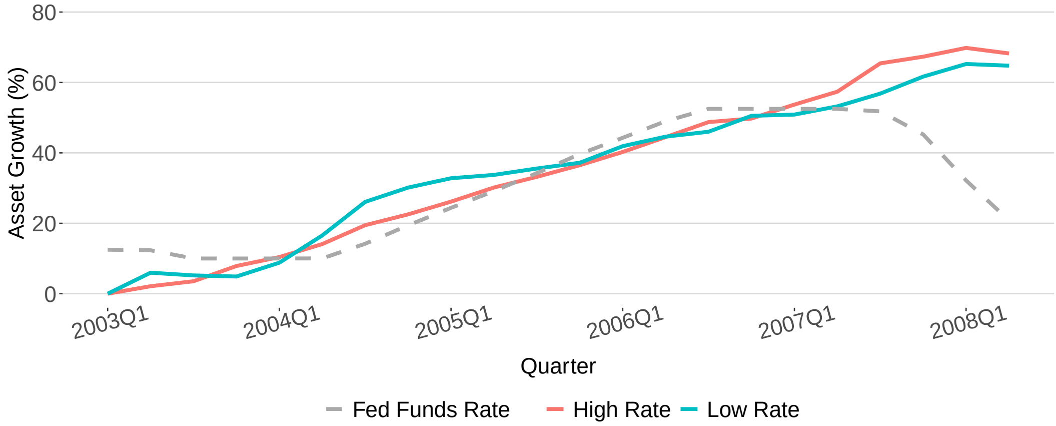
(d) 2021Q4-2023Q2



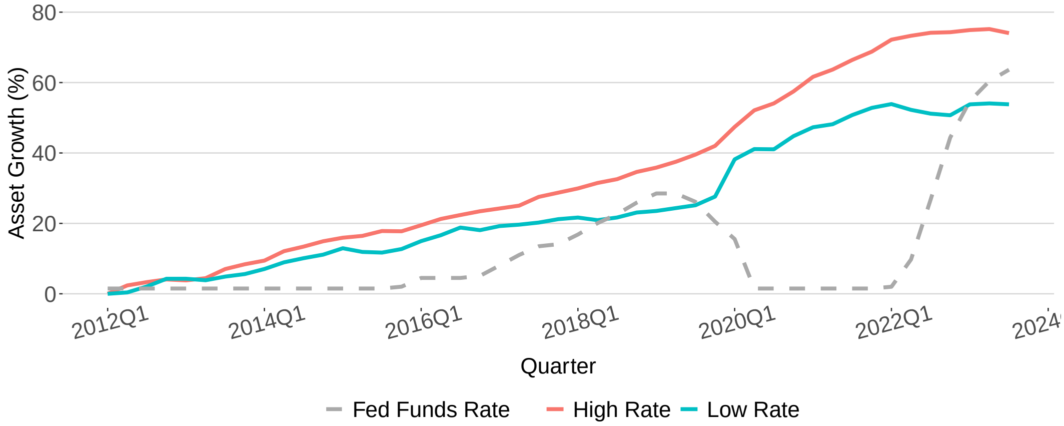
Notes: This figure compares the deposit growth of high and low rate banks among the top 100 banks over the three recent rate hiking cycles. Figures E.6a E.6b, E.6c, and E.6d compare the deposit growth experienced by high-rate banks to that of low-rate banks from 1993Q4 through 2001Q1, from 2004Q1 through 2007Q4, from 2015Q4 through 2019Q4, and from 2021Q4 through 2023Q2, respectively. To facilitate comparison, the growth rates of high-rate and low-rate banks are normalized to 0% in the first quarter of each rate hiking cycle, i.e. 2004Q1, 2015Q4, and 2021Q4. To mitigate the impact of large mergers and acquisitions (M&As) or outliers, we exclude BHC-quarter observations when the change in log deposits exceeds 50%. In total, 15 observations are excluded in 1993Q4-2001Q1 (panel a). The left y-axis represents the quarterly average Federal Fund Target rate (FFTar). A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MCD10K rate and deposit rate from the Call Report, falls within the top quartile.

Figure E.7: Asset Growth (Top 100 Banks)

(a) 2003Q1-2008Q2



(b) 2012Q1-2023Q3



Notes: This figure compares the asset growth of high and low rate banks for banks with more than $10 billion in assets. Figure E.7a compares the asset growth experienced by high rate banks to that of low rate banks from 2003Q1 through 2008Q2. Figure E.7b compares the asset growth experienced by high rate banks to that of low rate banks from 2012Q1 through 2023Q3. For ease of comparison, the growth rates of high rate and low rate banks are normalized to 0% in the first quarter, i.e., 2003Q1 and 2012Q1. The left y-axis represents the quarterly average Federal Fund Target rate (Fed Funds Rate). A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MCD10K rate and deposit rate from the Call Report, falls within the top quartile.

Table E.1: Bank Branches (Top 100 Banks)

	log(# Branches)		$\log(\frac{\text{Branches}}{\text{Deposit}})$		Branch-weighted County Average Age	
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}$(High Rate)×Post	-0.955***	-1.031***	-0.274	-0.347	-0.257***	-0.215*
	(0.207)	(0.224)	(0.241)	(0.245)	(0.092)	(0.109)
$\mathbb{1}$(High Rate)	-1.161***	-1.168***	-0.781***	-0.838***	-0.221***	-0.151*
	(0.154)	(0.161)	(0.228)	(0.229)	(0.079)	(0.085)
Post	0.557***		-0.846***		1.905***	
	(0.119)		(0.125)		(0.203)	
Constant	6.500***		1.995***		37.377***	
	(0.127)		(0.105)		(0.144)	
Controls + Quarter FE		✓		✓		✓
Adjusted R^2	0.225	0.231	0.111	0.080	0.244	0.041
Observations	8145	8145	8145	8145	7226	7226
Mean of Dep. Variable	6.589	6.589	0.880	0.880	38.603	38.603

Notes: This table reports the estimated coefficients from the following regression specification for the top 100 banks:

$$Y_{i,q} = \delta_q + \beta_1 \times \mathbb{1}_{\text{High Rate},i} \times \text{Post}_q + \beta_2 \times \mathbb{1}_{\text{High Rate},i} + \beta_3 \times Controls_{i,q-1} + \varepsilon_{i,q}$$

where i and q indicate the bank and quarter-year, respectively, $\mathbb{1}_{\text{High Rate}_i}$ denotes whether bank i is a high rate bank, $Post_t$ denotes the post-2009 period. Controls include $\text{ROA}_{i,q-1}$ and Tier $1_{i,q-1}$, which represent the return on assets and the tier 1 capital ratio from the previous quarter, respectively. The sample includes all banks with an average yearly asset value of over 10 billion. The dependent variable, $Y_{i,q}$ is the log-transformed number of branches (log(# of Branches)) in columns (1)-(2), the log-transformed ratio of branches to deposits in billions ($\log(\frac{Branches}{Deposit})$) in columns (3)-(4), and the average customer age in columns (5)-(6). The branch-weighted county average age is calculated as the county average age, which is weighted based on the number of branches in each county. The variable $\log(\frac{Branches}{Deposit})$ is winsorized at the 0.5% and the 99.5% levels. Branch and deposit data comes from the FDIC Summary of Deposits. A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MDC10K rate and deposit rate from the Call Report, falls within the top quartile. Each observation is weighted by its asset size in the previous quarter. Standard errors (in parentheses) are clustered at the quarter-year levels and are accounted for autocorrelation consistent errors using Driscoll-Kraay with 4-quarter lags. *, **, *** represent statistical significance at 10%, 5% and 1% level, respectively.

Table E.2: Credit Risk (Top 100 Banks)

Panel A: Loans and Securities

	Loan Rate	Credit Spread	Charge-offs
	(1)	(2)	(3)
$\mathbb{1}$(High Rate)×Post	1.068***	0.980***	0.194**
	(0.144)	(0.160)	(0.077)
$\mathbb{1}$(High Rate)	0.587***	0.744***	0.256***
	(0.095)	(0.143)	(0.067)
Quarter FE + Controls	✓	✓	✓
Observations	9053	7878	9053
Mean of Dep. Variable	5.267	3.495	0.839

Panel B: Charge-off Rates by Asset Class

	Real Estate Loans	C&I Loans	Personal Loans	Other Loans
	(1)	(2)	(3)	(4)
$\mathbb{1}$(High Rate)×Post	0.034	0.334***	0.218	0.082
	(0.046)	(0.079)	(0.166)	(0.052)
$\mathbb{1}$(High Rate)	0.093**	-0.033	0.234*	-0.055
	(0.036)	(0.066)	(0.139)	(0.038)
Quarter FE + Controls	✓	✓	✓	✓
Observations	8877	8704	8946	8523
Mean of Dep. Variable	0.429	0.629	2.162	0.248

Notes: This table reports the estimated coefficients from the following regression specification for the top 100 banks:

$$Y_{i,q} = \delta_q + \beta_1 \times \mathbb{1}_{\text{High Rate},i} \times \text{Post}_q + \beta_2 \times \mathbb{1}_{\text{High Rate},i} + \beta_3 \times Controls_{i,q-1} + \varepsilon_{i,q}$$

where i and q indicate the bank and quarter-year, respectively, $\mathbb{1}_{\text{High Rate}_i}$ denotes whether bank i is a high rate bank, $Post_t$ denotes the post-2009 period. Controls include $\text{ROA}_{i,q-1}$ and Tier $1_{i,q-1}$, which represent the return on assets and the tier 1 capital ratio from the previous quarter, respectively. The sample includes all banks with an average yearly asset value of over 10 billion. In panel A, the dependent variable, $Y_{i,q}$ is the loan rate in column 1, credit spread in column 2, and charge-off rate in column 3. The credit spread is computed as the difference between the loan rate and synthetic term rate (average of treasury yields, weighted by the share of loans with different maturities). Panel B analyzes the charge-off rate by asset class. The asset classes are real estate loans in column 1, other loans in column 2, mortgage-backed securities in column 3, and treasuries in column 4. All dependent variables are winsorized at the 0.5% and the 99.5% levels. A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MDC10K rate and deposit rate from the Call Report, falls within the top quartile. Each observation is weighted by its asset size in the previous quarter. Standard errors (in parentheses) are clustered at the quarter-year levels and are accounted for autocorrelation consistent errors using Driscoll-Kraay with 4-quarter lags. *, **, *** represent statistical significance at 10%, 5% and 1% level, respectively.

Table E.3: Maturity Risk (Top 100 Banks)

Panel A: Loans and Securities

	Maturities (years)	Short-term share (%)
	(1)	(2)
$\mathbb{1}$(High Rate)×Post	-0.705***	2.266
	(0.232)	(1.784)
$\mathbb{1}$(High Rate)	-1.409***	3.221**
	(0.216)	(1.380)
Quarter FE + Controls	✓	✓
Observations	8179	8179
Mean of Dep. Variable	5.738	47.590

Panel B: Maturity by Asset Class

	Real Estate Loans	Other Loans	MBSs	Treasuries
	(1)	(2)	(3)	(4)
$\mathbb{1}$(High Rate)×Post	-0.933***	0.226	-1.580***	-0.665
	(0.315)	(0.148)	(0.538)	(0.530)
$\mathbb{1}$(High Rate)	-1.121***	-0.342**	0.512	-0.681
	(0.251)	(0.135)	(0.531)	(0.455)
Quarter FE + Controls	✓	✓	✓	✓
Observations	7777	8178	8007	8013
Mean of Dep. Variable	11.836	2.092	16.537	5.984

Panel C: Share by Asset Class (%)

	Real Estate Loans	Other Loans	MBSs	Treasuries
	(1)	(2)	(3)	(4)
$\mathbb{1}$(High Rate)×Post	-1.595	5.935***	-0.979	-3.361**
	(1.132)	(1.541)	(0.684)	(1.417)
$\mathbb{1}$(High Rate)	-2.513**	3.249**	-5.382***	4.646***
	(1.078)	(1.235)	(0.598)	(1.211)
Quarter FE + Controls	✓	✓	✓	✓
Observations	8179	8179	8179	8179
Mean of Dep. Variable	14.998	59.490	11.539	13.972

Notes: This table reports the estimated coefficients from the following regression specification for the top 100 banks:

$$Y_{i,q} = \delta_q + \beta_1 \times \mathbb{1}_{\text{High Rate},i} \times \text{Post}_q + \beta_2 \times \mathbb{1}_{\text{High Rate},i} + \beta_3 \times Controls_{i,q-1} + \varepsilon_{i,q}$$

where i and q indicate the bank and quarter-year, respectively, $\mathbb{1}_{\text{High Rate}_i}$ denotes whether bank i is a high rate bank, $Post_t$ denotes the post-2009 period. Controls include ROA$_{i,q-1}$ and Tier $1_{i,q-1}$, which represent the return on assets and the tier 1 capital ratio from the previous quarter, respectively. The sample includes all banks with an average yearly asset value of over 10 billion. In panel A, the dependent variable, $Y_{i,q}$ is the maturity of loans and securities in column 1, and the share of loans and securities with less than one-year maturity in column 2. Panels B and C analyze maturities and asset share by asset class. The asset classes are real estate loans in column 1, other loans in column 2, mortgage-backed securities in column 3, and treasuries in column 4. The data comes from the Call Reports. Each observation is weighted by its asset size in the previous quarter. A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MDC10K rate and deposit rate from the Call Report, falls within the top quartile. Standard errors (in parentheses) are clustered at the quarter-year levels and are accounted for autocorrelation consistent errors using Driscoll-Kraay with 4-quarter lags. *, **, *** represent statistical significance at 10%, 5% and 1% level, respectively.

Table E.4: Deposit Betas (Top 100 Banks)

	ΔDep. Rate	ΔInterest Expense	ΔInterest Income	ΔNIM
	(1)	(2)	(3)	(4)
ΔFFTar×𝟙(High Rate)×Post	0.505***	0.169***	0.119*	-0.062
	(0.096)	(0.049)	(0.062)	(0.041)
ΔFFTar×𝟙(High Rate)	-0.023	-0.048	-0.042	0.009
	(0.066)	(0.037)	(0.058)	(0.035)
ΔFFTar	0.599***	0.459***	0.433***	-0.029
	(0.053)	(0.036)	(0.054)	(0.032)
ΔFFTar×Post	-0.446***	-0.150***	0.077	0.227***
	(0.095)	(0.050)	(0.065)	(0.043)
Controls	✓	✓	✓	✓
Adjusted R^2	0.554	0.552	0.263	0.053
Observations	7065	9047	9047	9047
Mean of Dep. Variable	-0.016	-0.000	-0.013	-0.013

Notes: This table reports the estimated coefficients from the following regression specification for the top 100 banks:

$$
\begin{aligned}
Y_{i,q} &= \alpha + \beta_1 \times \Delta\text{FFTar}_q \times \mathbb{1}_{\text{High Rate},i} \times \text{Post}_q + \beta_2 \times \Delta\text{FFTar}_q \times \mathbb{1}_{\text{High Rate},i} \\
&\quad + \beta_3 \times \Delta\text{FFTar}_q \times \text{Post}_q + \beta_4 \times \Delta\text{FFTar}_q + \beta_5 \times \mathbb{1}_{\text{High Rate},i} \\
&\quad + \beta_6 \times \mathbb{1}_{\text{High Rate},i} \times \text{Post}_q + \beta_7 \times Controls_{i,q-1} + \varepsilon_{i,q}
\end{aligned}
$$

where i and q indicate the bank and quarter-year, respectively, ΔFFTar_q denotes the change in the Federal Funds Target Rate, $\mathbb{1}_{\text{High Rate}_i}$ denotes whether bank i is a high rate bank, Post_q denotes the post-2009 period. Controls include ROA$i, q-1$ and Tier 1$i, q-1$, which represent the return on assets and the tier 1 capital ratio from the previous quarter, respectively. The sample includes all banks with an average yearly asset value of over 10 billion. The dependent variable, $Y_{i,q}$ is the change in the 12MCD10K rate in column (1), the change in interest expense ($\Delta\text{Interest Expense}_{i,q}$) in column (2), the change in net interest income ($\Delta\text{Interest Income}_{i,q}$) in column (3), and change in NIM ($\Delta\text{NIM}_{i,q}$) in column (4). The 12MCD10K rate comes from RateWatch. The change in the loan rate, interest expense, interest income and NIM are computed from the Call Reports. All dependent variables are winsorized at the 0.5% and the 99.5% levels. See Table C.1 for more details on the construction of key variables. A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MDC10K rate and deposit rate from the Call Report, falls within the top quartile. Each observation is weighted by its asset size in the previous quarter. Standard errors (in parentheses) are clustered at the quarter-year levels and are accounted for autocorrelation consistent errors using Driscoll-Kraay with 4-quarter lags. *, **, *** represent statistical significance at 10%, 5% and 1% level, respectively.

Table E.5: Deposit Growth and Loans (Top 100 Banks)

	$\Delta\text{Deposit}_{i,y}$		$\Delta\text{Personal Loan}_{i,y}$		$\Delta\text{C\&I Loan}_{i,y}$		$\Delta\text{Real Estate Loan}_{i,y}$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta\text{FFTar}_y \times \mathbb{1}(\text{High Rate}) \times \text{Post}$	5.601***	5.587**	9.402**	9.969**	2.408	1.879	2.025	2.663
	(1.935)	(2.155)	(3.717)	(3.999)	(2.481)	(2.678)	(2.482)	(3.107)
$\Delta\text{FFTar}_y \times \mathbb{1}(\text{High Rate})$	-3.208**	-3.005*	-7.560**	-7.848**	-0.396	0.410	-2.216	-2.300
	(1.514)	(1.609)	(3.384)	(3.593)	(1.513)	(1.605)	(1.431)	(1.537)
$\Delta\text{FFTar}_y \times \text{Post}$	-6.897***		-2.544		-3.100		-4.632**	
	(1.368)		(1.752)		(2.767)		(2.173)	
Controls + Quarter FE		✓		✓		✓		✓
Adjusted R^2	0.084	0.016	0.036	0.019	0.025	0.012	0.087	0.016
Observations	9053	9053	8876	8876	8586	8586	8795	8795
Mean of Dep. Variable	19.611	19.611	13.355	13.355	14.046	14.046	14.455	14.455

Notes: This table reports the estimated coefficients from the following regression specification for the top 100 banks:

$$\begin{aligned}\Delta Y_{i,y} &= \alpha + \beta_1 \times \Delta\text{FFTar}_y \times \mathbb{1}_{\text{High rate},i} \times \text{Post}_q + \beta_2 \times \Delta\text{FFTar}_y \times \mathbb{1}_{\text{High rate},i} + \beta_3 \times \Delta\text{FFTar}_y \times \text{Post}_q \\ &\quad + \beta_4 \times \Delta\text{FFTar}_y + \beta_5 \times \mathbb{1}_{\text{High rate},i} + \beta_6 \times \mathbb{1}_{\text{High rate},i} \times \text{Post}_q \\ &\quad \beta_7 \times \Delta\text{FFTar}_y \times \mathbb{1}_{\text{High rate},i} \times \text{Crisis} + \beta_8 \times \mathit{Controls}_{i,q-1} + \varepsilon_{i,q},\end{aligned}$$

where i and q indicate the bank and quarter-year, respectively, ΔFFTar_y denotes the annual change in the Federal Funds Target Rate, $\mathbb{1}_{\text{High rate}_i}$ denotes whether bank i is a high rate bank, Post_q denotes the post-2009 period, "Crisis" is an indicator for the third and fourth quarters of 2008. Controls include ROA$i, q-1$ and Tier 1$i, q-1$, which represent the return on assets and the tier 1 capital ratio from the previous quarter, respectively. The dependent variable, $\Delta\text{Deposit}_{i,y}$ is the annual growth of the total deposit of bank i. A bank is categorized as a *high rate* bank if its average rank, calculated based on the 12MDC10K rate and deposit rate from the Call Report, falls within the top quartile. Each observation is weighted by its asset size in the previous quarter. Standard errors (in parentheses) are clustered at the quarter-year levels and are accounted for autocorrelation consistent errors using Driscoll-Kraay with 4-quarter lags. *, **, *** represent statistical significance at 10%, 5% and 1% level, respectively.