Revenge of the S&Ls:
How Banks Lost a Half Trillion Dollars during 2022

Abstract: During 2022, U.S. commercial banks reported more than $500 billion in unrealized losses on their investment securities portfolios as the Federal Reserve Board raised its target interest rate by 400 basis points to combat inflation. In many ways, this was strikingly similar to the unrealized losses on residential mortgages experienced by savings & loans in the early 1980s as the Federal Reserve Board raised interest rates to combat inflation – despite the regulatory reforms that were put into place after that crisis. In this study, we analyze the role of investments by banks in different types of securities (Treasuries, munis, RMBS, and CMBS) and different types of mortgages (commercial and residential) in explaining these losses. We find that investments in RMBS were the most pernicious, as banks "reached for yield" during 2020-2021 as they coped with massive deposit inflows associated with pandemic relief programs. We also investigate whether markets price these losses, and whether, if such recognition is not occurring, there is a need for better regulatory oversight of interest rate risk. We find mixed evidence on the market pricing of these losses.

Keywords: bank failure, interest-rate risk, mortgage, mortgage-backed securities, uninsured deposits

JEL Classifications: G01, G21, G28

DRAFT: 04/01/2024

1. Introduction

The bank-related events of the spring of 2023 – when three of the 20 largest commercial banks in the United States were closed by prudential regulators,[1] amid concerns about depositor runs and contagion and with substantial costs to the Federal Deposit Insurance Corporation (FDIC) – once again have focused the attention of policymakers on U.S. commercial banks and their investments in assets backed by real estate.

There have been three major banking crises over the last 50 years. Besides the Great Financial Crisis (GFC) and the foreclosure tsunami that resulted from credit risk, there was an earlier credit risk crisis: In the late 1980s and early 1990s, more than 1,000 commercial banks failed, and the primary reasons for these failures were losses in commercial real estate investments, particularly in commercial mortgages and construction loans. Two decades later, alongside the GFC, more than 500 banks failed, and once again the primary reasons for these failures were losses on investments in commercial mortgages and construction loans (See Figure 1). But in both of those crises, credit risk was to blame for the losses on mortgages. Basel III, and, in many countries, macro-prudential policies have been put into place to guard against systemic crises due to excessive default risk.

To find a parallel for the current crisis, we have to go back to the late 1970s and early 1980s when rising interest rates caused massive losses and failures among savings & loan institutions that invested heavily in fixed-rate residential mortgages. As then, today's banking woes are the result of rapidly rising interest rates caused by the Federal Reserve's battle against inflation. When interest rates rise, fixed-rate mortgages and securities that are backed by such mortgages lose value. As banks write down their investments in such assets backed by real

[1] These three banks were the second-, third-, and fourth-largest bank failures in U.S. history in terms of assets, behind only the 2008 failure of Washington Mutual.

estate, their capital is depleted, causing regulators to step in and close those institutions whose losses exceed their equity.

In this study, we quantify the embedded securities losses that resulted due to the interest-rate risks that many commercial banks undertook when they invested large deposit inflows during 2020-2021 into long-dated securities – especially into residential mortgage-backed securities (RMBS) and municipal bonds. These losses were the immediate consequence of the sharp increase in policy rates that began in the spring of 2022. We then ask whether banks that specialize in commercial real estate lending have also suffered from heavy exposure to interest rate losses on their securities' portfolio, which has consequences for their ability to extend loans to the distressed commercial real estate sector. Regional, mid-size, and small banks in particular are known for their heavy exposure and strengths in lending to local real estate. The fact that today many local commercial real estate owners are under duress and lending is being curtailed could potentially be due to those banks' interest rate losses on RMBS, in addition to their credit risk exposure in their commercial real estate lending.

We focus first on the embedded securities losses on banks' balance sheets as of mid-2023, by type of security. Using bank financial data, we show that these losses are positively associated with banks' holdings of Treasury securities, municipal government securities, RMBS, and CMBS, which are longer duration—but the losses are much more strongly associated with muni securities and RMBS than with Treasuries and CMBS. In essence, it appears that the banks' efforts at "reaching for yield" and the consequent securities losses took place through banks' holdings of all of these kinds of securities – but the longer durations (and higher initial yields) of RMBS and munis translated into losses per dollar of holdings that were much larger

than the losses on Treasuries and CMBS. These losses rose with the FOMC announcements of increases in its target Federal Funds rate.

2. Background

Surprisingly, perhaps, there was no 2020 or 2021 banking crisis in response to the Covid-19 Pandemic. Unemployment spiked for several months. GDP plummeted. But the Federal Government propped up consumers, businesses, and the U.S. economy with a wide array of relief programs. As shown in Figure 2, this resulted in $6 trillion in deficit spending during 2020 and 2021. This massive deficit spending during the pandemic period by the federal government continued into 2022 and 2023, as the national debt rose by another $3 trillion.

As shown in Figure 3, much of this fiscal stimulus ended up as bank deposits. During 2020, total deposits grew by more than $3 trillion, from $13 trillion to $16 trillion. During 2021, deposits grew another $2 trillion. More than $2 trillion of the deposit inflows ended up invested in securities. This increased the amount of investment securities by more than half, from $3.6 trillion in 2019 to $5.6 trillion in 2021. Banks invested primarily in long-dated securities – especially RMBS securities – in a reach for yield.

As shown in Figure 4, the massive fiscal stimulus inevitably led to rising inflation. Initially, both Fed Chairman Powell and the Treasury Secretary Yellen insisted that this inflation was “transitory” and would quickly subside. Unfortunately, inflation was not “transitory.” Instead, it accelerated during the first half of 2022, peaking at 9.1% (on a year-over-year basis for the CPI) in June. This forced the Fed to act in a decisive manner.

When the pandemic began during early 2020, the Fed responded by cutting its policy rate from about 2.5% to 0.08%. However, as shown in Panel A of Figure 5, beginning in March

2022, the Fed raised the target Fed Funds Rate from 0.08% to 5.33% in August 2023. This was the fastest rate increase in the Fed's history.

As shown in Panel B of Figure 5, the Treasury-bond market already had been responding to rising inflation during 2021. The yield on the 10-Year Treasury bond had risen to 2.0% before the first Fed rate hike in March 2022. Since then, it has risen to 5.0% before retreating to 4.5%. Residential mortgage rates for 30-year fixed-rate mortgages (as reported by Freddie Mac[1]) rose from a low of 2.77% (in the week of 8/5/2021) to a peak of 7.79% (in the week of 10/26/2023), most recently falling back to 7.03% (in the week of 12/7/2023).

3. Literature Review

Banks intermediate both credit risk and interest rate risk and, according to the literature, may increase investment risk to boost returns in low-interest-rate environments where investment opportunities for financial intermediaries offer insufficient returns (Borio and Zhu, 2012; Cole and Silverstein, 2023. It is referred to as "reaching for yield" when banks increase their interest-rate risk during periods of loose monetary policy. Prior research has established that financial risk taken by financial intermediaries during periods of low-interest rates negatively affects the general financial stability of the banking sector (Claessens et al., 2017; Hanson and Stein, 2015; Jiménez et al., 2014; Rajan, 2006), which raises the question as to why and how this occurred again in during 2020-2023.

During the 1980s, risk management failures at all levels, including management of interest rate risk, contributed to the collapse of many S&Ls (Curry and Shibut, 2000; Sheng, 1996; White, 1991). In response to the massive losses of approximately $150 billion and the

[1] See https://www.freddiemac.com/pmms/docs/historicalweeklydata.xlsx .

need to restore confidence and stability in the banking system, new regulations such as the Federal Deposit Insurance Corporation Improvement Act (1991) and the 1988 BIS agreement on capital requirements were passed.[2]

The duration measure of a security is an accurate measure of the interest rate risk (sensitivity) embedded in a security and can be used to quantify interest rate risk (Bierwag, 1977; Bierwag et al., 1983; Reitano, 1992; Mantilla-Garcia et al. 2022). The fundamental risk management strategy using the duration measures is to match the interest rate sensitivities of assets and liabilities while respecting future liquidity needs to reduce interest rate risk. This type of interest rate risk management reduces overall firm risk and is used by many financial intermediaries (Babbel and Klock, 1994; Lamm-Tennant, 1989; Leibowitz, 1986; Bookstaber and Gold, 2015).

The banking model is unique since there is an inherent duration gap between assets (loans and securities) and liabilities (deposits), which should, on average, require more careful monitoring by banks relative to other intermediaries that target a "zero-gap" policy. Cole and Silverstein (2023) examine the duration gap of banks and find that, on average, banks ignored this risk and reached for yield during the 2020 pandemic COVID-19 period, experiencing significant losses that led to multiple bank failures and instability in the sector.

We build on this research in several ways. First, we examine banks' excessive risk-taking that increased portfolio allocations into the RMBS and municipal bonds, which bore the largest losses of any class of security held by banks. Second, we specifically examine banks specializing in real estate lending to determine if the losses in their security portfolios were mostly due to

[2] See Curry & Shibut (2000) and White, L. J. (1991, pp. 196-197).

investments in these risky securities and ultimately impaired their ability to extend credit to the commercial real estate sector. Third, we conduct a series of event studies around FOMC announcements of interest rate increases to determine the extent to which the market recognized the greater security portfolio losses incurred by banks that reached for yield. Finally, we extend our event study and focus on real-estate-focused banks to see if the market recognizes increased exposure to highly rate-sensitive RMBS and illiquid municipal bonds.

The literature has suggested the potential for banks' interest rate risk to be concentrated in agency RMBS and Treasury securities (Fuster and Vickery, 2018). Both types of securities allow the banks to extend the duration of their security portfolios. The agency RMBS provides additional compensation for bearing prepayment risk, which makes them attractive for banks seeking yield in a low-rate environment above and beyond that offered by Treasuries (Becketti, 1989; Diep, Eisfeldt and Richardson, 2021). As of the fourth quarter of 2021, the overall market for agency MBS represented approximately $10.7 trillion of market value.[3]

The prepayment risk embedded in agency RMBS causes them to have negative convexity, posing additional risk management considerations for yield-seeking banks (Duarte, Longstaff, and Yu, 2007; Hanson, Shleifer, Stein and Vishny, 2015; Aytek, Mueller, Vendolin, and Venter, 2016). Unlike Treasury securities, as interest rates rise, the embedded prepayment risk will cause the duration of the RMBS to *increase* (interest-rate-related price risk) as the market prices in a lower likelihood of prepayment to the RMBS. Similarly, mortgage borrowers may exercise their right to prepay as rates fall, lowering the RMBS's duration. Despite the importance and size of the RMBS market that institutional investors dominate, the banks investing in RMBS require a level of sophistication to understand the incremental interest rate

[3] https://www.sifma.org/resources/research/us-mortgage-backed-securities-statistics/

risk over Treasuries driven by the prepayment option of the mortgage borrower (Diep, Eisfeldt, and Richardson, 2021).

Banks may also seek additional risk premiums in the $4.0 trillion municipal bond market when they reach for yield.[4] Municipal bonds are typically tax-exempt and contain credit and liquidity premiums, making them attractive investments for banks. Despite the rarity of municipal bond defaults and the tendency to be held to maturity, they offer attractive cash flows relative to Treasury securities due to these additional risk premiums (Ang, Bhansali, and Xing, 2010; Longstaff, 2011; Wang, Wu, and Zhang, 2008).

Somewhat similar to RMBS with prepayment risk, municipal bonds carry an additional risk premium over Treasuries in the form of credit and liquidity premiums. Uncertain monetary policy, interest rate volatility, and rate increases have a positive and significant effect on the liquidity premium of municipal bonds – which is reflected in their yield (Bagley, Gissler, Hiteshew, and Ivanov, 2023). Rising liquidity premiums of municipal bonds in times of rising rates lead to unexpected security losses relative to Treasuries with the same duration and require sophisticated risk management considerations for banks that are reaching for yield.

How the markets recognize the interest rate, prepayment, and liquidity risks taken by individual banks that reach for yield is not well understood. English, Van den Heuvel, and Zakrajsek (2018) use high-frequency intraday stock return data of bank holding companies (BHCs) in an event study and find that the level and slope of the yield curve around the time of FOMC announcements are associated with a significant change in bank equity values. As expected, the effects attributable to changes in the level are greater for banks holding larger

[4] As of November 2023. https://www.sifma.org/resources/research/us-municipal-bonds-statistics/

deposits, and those attributable to slope are greater for banks engaging in maturity transformation.

We contribute to this market efficiency research by examining equity market responses to the risk-taking by banks on their balance sheets during the COVID-19 pandemic when the Federal Reserve subsequently (in the spring of 2022) raised interest rates. In addition to addressing the aggregate banking sector, we test for whether banks that specialize in commercial real estate invest in securities subject to interest rate risk. We test for whether and the degree to which equity markets generally recognized banks' exposure to interest rate risk.

4. Data and Methodology

4.1 Data

Our data come from the Federal Financial Institutions Examination Council (FFIEC) Reports of Condition and Income, commonly referred to as the "Call Reports" among researchers and regulators. These data are the publicly available quarterly financial reports that U.S. banks are required to file with their regulatory agencies. In addition to these data, we also rely on the Center for Research in Security Prices (CRSP) dataset to obtain stock pricing data for our subsample of publicly traded banks.

In order to match bank regulatory data with CRSP stock price data, we rely on the Federal Reserve Bank of New York's CRSP-FRB link table. These links are utilized to obtain the subsample of banks that fit our research design. We select those banks with pricing data that match our sample period and conduct further analysis to ensure accurate matching between bank regulatory data and stock market pricing data.

Our bank-level data are expressed as a ratio with respect to the bank's total assets unless noted otherwise. We limit the effects of outliers by winsorizing our data at the 0.01 and 0.99 levels. This procedure is done for each quarter year of our sample period.

4.2 Methodology

We utilize both univariate and multivariate analysis to provide evidence on the determinants of unrealized losses on banks' securities portfolios and the timing for the market's recognition of these losses. First, we present a series of charts showing the evolution of bank securities portfolios from Q1 2017 through Q2 2023 and the evolution of gains and losses on those securities portfolios during the same period.

Second, we present univariate statistics separately for banks with high and low unrealized losses on their securities portfolio. We create two subsamples of banks based upon the median ratio of unrealized losses to total assets. We then analyze what types of bank assets were disproportionately present (or absent) in the portfolios of the high-loss group of banks relative to the low-loss group of banks.

Next, we utilize multivariate regression models to provide multivariate evidence on the determinants of banks' unrealized securities losses. We estimate a series of OLS regressions where the dependent variable is the ratio of unrealized securities losses to total assets and the explanatory variables are bank portfolio allocations of their assets to different types of securities and mortgages:

$$\text{loss ratio}_i = \beta_0 + \beta_1 \text{ x treasecta}_i + \beta_2 \text{ x munisecta}_i + \beta_3 \text{ x rmbsta}_i + \beta_4 \text{ x cmbsta}_i + \beta_5 \text{ x resmortta}_i + \beta_6 \text{ x cremortta}_i + e_i \quad (1)$$

where:

loss ratio $_i$ is the ratio of unrealized security losses to assets;

treasecta$_i$ is the ratio of Treasury securities to assets;

munisecta$_i$ is the ratio of municipal securities to assets;

rmbsta$_i$ is the ratio of residential mortgage-backed securities (RMBS) to assets;

cmbsta$_i$ is the ratio of commercial mortgage-backed securities (CMBS) to assets;

resmortta$_i$ is the ratio of residential mortgages to assets;

cremortta$_i$ is the ratio of commercial mortgages to assets; and

e$_i$ is an i.i.d error term.

In these regressions, we measure unrealized losses to assets as of June 30, 2023. We measure each of our explanatory variables as of Dec. 31, 2021, to capture the portfolio allocations just prior to the first increase in the Federal Funds Rate by the FOMC (in March 2022).

4.3 Additional Analysis (to be completed): Evidence from Event Studies

4.3.1 Failure of Silicon Valley Bank

We test for whether the major declines in bank stock values that occurred around the failure of Silicon Valley Bank on March 10, 2023, similarly reflected the disproportionate losses of banks heavily exposed to interest-rate risk and to uninsured deposits. First, we estimate abnormal returns around the failure date by regressing daily stock returns for publicly traded banks against the returns on the S&P 500 market index. We estimate abnormal returns by two methods. First, we estimate a one-factor (CAPM) model; second, we estimate a three-factor Fama-French model.

Next, we use the daily abnormal returns (ARs) from these two regression models as the dependent variable in a second-stage "difference-in-differences" analysis where the failure of Silicon Valley Bank is our exogenous shock. We split our sample of publicly traded bank

holding companies into three groups: (i) above and below the median repricing maturity;[5] (ii) above and below the median ratio of uninsured deposits to total assets; and (iii) above and below the median ratio of unrealized securities losses to total assets.

4.3.2 FOMC Announcements of Interest Rate Hikes

Using stock-return data from CRSP and financial information from the bank Call Reports, we will test for whether markets recognized the greater losses of the banks that were heavily exposed to securities with embedded interest-rate risk. We will perform a series of event studies that focus on the FOMC announcements of interest rate increases: beginning on March 17, 2022, and extending through the subsequent announced rate rises. First, we will estimate excess returns around the announcement dates by regressing daily stock returns for publicly traded banks against the returns on the S&P 500 market index. Second, we will use the vector of the cumulative abnormal returns (CARs) from these regressions as the dependent variable in a second-stage analysis where our focal explanatory variables are the ratio of unrealized securities losses to total assets for these same banks, and the portfolio allocations to different types of securities and mortgages for these same banks.

4.3.3 Partial Rollback of Dodd-Frank Reporting Rules

We further test whether the partial roll-back of the Dodd-Frank reporting rules for small- and medium-sized banks in 2018 affected these banks' exposure to interest rate risk. First, we will estimate excess returns around the announcement dates for the regulatory change by regressing daily stock returns for publicly traded banks against the returns on the S&P 500 market index. Second, we will use the vector of the cumulative abnormal returns (CARs) from these regressions as the dependent variable in a second-stage analysis where our focal explanatory

[5] We estimate repricing maturity using the bank Call Report data, which allocates securities into maturity buckets. We use the midpoints of each maturity bucket and calculate a weighted average maturity for each bank each quarter.

variables are the portfolio allocations to different types of securities and mortgages for these same banks.

5. Results

5.1 Univariate Analysis

5.1.1 Evolution of Bank Securities Portfolios during 2017 – 2023

Panels A – C of Figure 6 document the evolution of bank securities portfolios as percentages of CET1 capital and of total assets by bank size during the period Q1 2017 through Q2 2023.

Panel A presents the evolution for banks with less than $10 billion in assets, which account for more than 95% of the approximately 5,000 commercial banks operating in the U.S. during this period but only 15 percent of bank assets. From Q1 2017 through Q1 2020, we see a steady decline in the size of the securities portfolio relative to both capital and assets. Once the pandemic hits in Q1 2020, the size of the securities portfolio rises sharply each quarter through Q1 2022, when the FOMC announces the first increase in its target Federal Funds Rate—from 18% of assets to 25% of assets. From Q1 2022 through Q2 2023, the size of the securities portfolio falls slightly (from 25% of assets to 24% of assets).

Panel B presents the evolution for the approximately 150 banks with $10 - $100 billion in assets that account for about 15% of aggregate bank assets. From Q1 2017 through Q1 2020, we again see a steady decline in the size of the securities portfolio relative to both capital and assets. Once the pandemic hits in Q1 2020, the size of the securities portfolio rises sharply each quarter through Q1 2022, when the FOMC announces the first increase in its target Federal Funds Rate—from 17% of assets to 22% of assets. From Q1 2022 through Q2 2023, the size of the securities portfolio falls (from 22% of assets to 20% of assets).

Panel C presents the evolution for the approximately 40 banks with more than $100 billion in assets that account for about 70% of aggregate bank assets. From Q1 2017 through Q1 2020, we again see a steady decline in the size of the securities portfolio relative to both capital and assets. Once the pandemic hits in Q1 2020, the size of the securities portfolio rises sharply each quarter through Q1 2022, when the FOMC announces the first increase in its target Federal Funds Rate—from 18% of assets to 22% of assets. From Q1 2022 through Q2 2023, the size of the securities portfolio falls (from 22% of assets back to 18% of assets).

5.1.2 Evolution of Unrealized Gains/Losses on Bank Securities Portfolios during 2017 – 2023

Panels A – C of Figure 7 document the evolution of the percentage of unrealized gains/losses on bank securities portfolios by type of security and bank size during the period Q1 2017 through Q2 2023. In each panel, we see the percentage gains/losses on the total securities portfolio and on each of the four components (Treasury securities, muni securities, RMBS, and CMBS). Panels A, B, and C present the evolution for banks with less than $10 billion in assets, $10 billion to $100 billion in assets, and $100 billion to $250 billion in assets, respectively.

In general, the three charts look very similar; consequently we will focus in our discussion on the largest banks, as that is where the three large bank failures occurred during Spring 2023: From Q1 2017 to Q3 2018, we see increasing losses on each of the four types of securities, with percentage losses on total securities bottoming at about 3%. From Q3 2018 through Q2 2020, losses were reversed and turned into a percentage gain of about 4%. From Q2 2020 through Q4 2021, these gains were slowly erased. From Q4 2021 to Q3 2022, losses accelerated to -10%, and then recovered slightly from Q3 2022 to Q2 2023 but remained down by 9%. By type of security, losses were greatest on RMBS (-11%) and CMBS (-10%) and smallest on Treasuries (-6%) and munis (-7%).

5.1.3 Descriptive Statistics

Table 1 presents descriptive statistics for our sample of 4,697 banks based upon the financial data that they provided to their regulators as of June 30, 2023. The average bank reported unrealized securities losses equal to 2.5 percent of total assets with a range from zero to 18.9 percent.[6] On average, banks invested 8.2 percent of assets in Treasury securities, 7.6 percent in municipal government securities, 7.4 percent in RMBS, and only 1.0 percent in CMBS. The average bank reported that residential mortgages ("whole loans") accounted for 17.2 percent of assets, while commercial mortgages accounted for 15.9 percent of assets. The average bank had a ratio of equity capital to assets of 11.3 percent and a ratio of common-equity Tier 1 capital to assets of 12.7 percent.

5.1.4 Differences in Means

Table 2 presents descriptive statistics for two groups of banks based upon the median ratio of unrealized securities losses to assets, along with a t-test for significant differences in the means of the two groups of banks. The difference in means is statistically significant at better than the 0.1 percent level for every variable in the table. The average allocation of assets to Treasury securities for high-loss banks was 10.3 percent but was only 6.1 percent for low-loss banks. For municipal securities, the average allocation by high-loss banks was 12.1 percent but was only 3.1 percent for low-loss banks. For RMBS, the average allocation by high-loss banks was 11.8 percent but was only 3.0 percent for low-loss banks. For CMBS, the average allocation by high-loss banks was 1.6% but was only 0.4 percent for low-loss banks.

[6] It is important to keep in mind that these unrecognized losses are reported by banks only for their securities portfolios. It is likely that other long-dated loan assets of banks – such as residential mortgage loans ("whole loans") and commercial real estate mortgage loans – experienced decreases in values that are comparable to the reported losses on securities; but banks are not required to compute or report the unrecognized losses on these direct mortgage loans. Jiang et al. (2023) estimate that the overall mark-to-market losses on all bank assets as of Q1 2023 were about $2.2 trillion, which was about four times the size of the reported aggregate losses on just the banks' securities.

When we turn to real-estate mortgages, we see just the opposite. For residential mortgages, the average allocation by high-loss banks was 15.2 percent but was 19.2 percent for low-loss banks. For commercial mortgages, the average allocation by high-loss banks was 13.5 percent but was 18.4 percent for low-loss banks.

As a summary: It is clear that the banks with the greater unrealized losses in securities were more heavily invested in all of the categories of long-dated securities than were the banks with smaller unrealized losses – and the differences were especially large for RMBS and municipal securities. At the same time, the banks with the larger securities losses were less heavily invested in straight residential and commercial real estate mortgages than were the lower-loss banks. Thus, the former banks' "reach for yield" was manifested more through securities investments than through local real estate lending.[7]

5.1.5 Correlation Analysis

Table 3 shows the correlations among our analysis variables. In column 3 are the correlations of each variable with the ratio of securities losses to assets. Unsurprisingly, each of the four types of securities has significant positive correlations with the loss ratio. The correlations are highest for municipal securities (0.606), followed by RMBS (0.575), CMBS (0.257), and Treasury securities (0.220). When we examine our two categories of real-estate mortgages, we find that each has a significant *negative* correlation with losses. The correlation for commercial mortgages is -0.252, while the correlation for residential mortgages in -0.168.[8]

[7] As we noted above, there are likely to be sizable unrecognized (but unreported) losses on banks' local real estate loans. But these loans represent banks' catering to the financial demands of their communities and (as these differences-in-means and the correlations reported below indicate) appear less likely to be deliberate efforts to "reach for yield."

[8] It is also worth noting that, as Table 3 shows, the correlation between banks' CMBS/assets and CRE lending/assets is essentially zero, and the correlations between banks' RMBS/assets and residential mortgage lending/assets is negative.

These correlations indicate that unrealized securities losses were *lower* for banks that hold more real-estate mortgages but were *higher* for banks that have larger securities portfolios.

Thus, the conclusions from these correlations reinforce what was learned in the previous sub-section with respect to the differences in means between the large-loss and small-loss banks: The "reach for yield" by the former group was manifested through securities and not through local real estate lending.

5.2 Multivariate Analysis

5.2.1 Cross-Sectional Regression Analysis

Table 4 presents the results from estimating a series of seven ordinary-least-squares regression models where the dependent variable is the ratio of unrealized securities losses to assets (as of June 30, 2023) and the explanatory variables are bank portfolio allocations of their assets to different types of securities and mortgages (as of December 31, 2021, prior to the first Fed announcement of interest rate increases in March 2022). In the first six columns of the table, we enter each of the explanatory variables separately. In the seventh column, we include all six of our explanatory variables.

In column 1, we include only the ratio of Treasury securities to assets. The 0.0641 coefficient is statistically significant at better than the 0.1 percent level and indicates that each one percentage point increase in the ratio of Treasury securities to assets increased unrealized securities losses by 6.41 basis points. The average bank allocated 8.2 percent of its assets to Treasury securities. The R-square of this model indicates that the ratio of Treasury securities to assets explains about six percent of the variation in the ratio of unrealized losses to assets.

In column 2, we include only the ratio of municipal government securities to assets. The 0.135 coefficient is statistically significant at better than the 0.1 percent level and indicates that

each one percentage point increase in the ratio of muni securities to assets increased unrealized securities losses by 13.5 basis points. The average bank allocated 7.6 percent of its assets to muni securities. The R-square of this model indicates that the ratio of muni securities to assets explains about 34 percent of the variation in the ratio of unrealized losses to assets.

In column 3, we include only the ratio of RMBS to assets. The 0.143 coefficient is statistically significant at better than the 0.1 percent level and indicates that each one percentage point increase in the ratio of RMBS to assets increased unrealized securities losses by 14.3 basis points. The average bank allocated 7.4 percent of its assets to RMBS. The R-square of this model indicates that the ratio of RMBS securities to assets explains about 33 percent of the variation in the ratio of unrealized losses to assets.

In column 4, we include only the ratio of CMBS to assets. The 0.209 coefficient is statistically significant at better than the 0.1 percent level and indicates that each one percentage point increase in the ratio of CMBS to assets increased unrealized securities losses by 20.9 basis points. The average bank allocated only 1.0 percent of its assets to CMBS. The R-square of this model indicates that the ratio of CMBS securities to assets explains about six percent of the variation in the ratio of unrealized losses to assets.

In column 5, we include only the ratio of residential mortgages to assets. The -0.0305 coefficient is statistically significant at better than the 0.1 percent level and indicates that each one percentage point increase in the ratio of residential mortgages to assets is associated with reduced unrealized securities losses by 3.1 basis points. The average bank allocated 17.2 percent of its assets to residential mortgages. The R-square of this model indicates that the ratio of residential mortgages to assets explains only about three percent of the variation in the ratio of unrealized losses to assets.

In column 6, we include only the ratio of commercial mortgages to assets. The -0.0544 coefficient is statistically significant at better than the 0.1 percent level and indicates that each one percentage point increase in the ratio of commercial mortgages to assets is associated with reduced unrealized securities losses by 5.4 basis points. The average bank allocated 15.92 percent of its assets to commercial mortgages. The R-square of this model indicates that the ratio of commercial mortgages to assets explains about seven percent of the variation in the ratio of unrealized losses to assets.

Finally, in column 6, we include all six of our explanatory variables. In this model, the coefficients on each of the four securities variables maintain strong statistical significance and the magnitudes of the coefficients do not change much – with the notable exception of CMBS to assets, which drops from 0.209 to only 0.103. The coefficients on the two mortgage variables flip from negative to slightly positive, but the statistical significance of each drops off sharply. The R-square of this model indicates that our six explanatory variables together explain more than 70 percent of the variation in the ratio of unrealized losses to assets. Unreported regressions show that a model that includes just muni securities and RMBS explains more than 60 percent of the variation in the ratio of unrealized losses to assets.

5.2.2 Event Study Analysis of the Failure of Silicon Valley Bank

To assess the impact of the failure of Silicon Valley Bank, we examine daily abnormal returns for publicly traded bank stocks with less than $250 Billion in assets sorted by interest rate risk and liquidity risk. Our initial sample consists of 281 publicly traded banks, from which we use the top and bottom quartiles sorted by interest-rate risk and liquidity risk to test the parallel-trend assumption. We define March 9, 2023, as the event date (day 0). The estimation period to derive parameters for estimating expected returns surrounding the SVB failure is 150 trading

days before the event to 15 trading days before the SVB failure. A minimum of 90 days of non-missing daily returns is required for inclusion in the sample of abnormal returns. We then match the abnormal return data to the banks in each top and bottom quartile of the respective risk factor. Figures 9 and 10 present the trend in average daily abnormal returns for the top and bottom quartiles of our sample of publicly traded bank holding companies estimated using the market model split by interest-rate risk and liquidity risk, respectively.

Figure 9 plots abnormal returns for two groups of banks based upon interest-rate risk: those in the top (high-interest-rate risk) and bottom quartiles (low interest-rate risk) of securities repricing maturities reported for Q4 2022. For the high interest-rate group, we see negative and highly significant abnormal returns of -7.0 percent on Thursday, Mar. 9 and of -10.5 percent on Monday, Mar. 13. Surprisingly, there was an insignificant abnormal return on Mar. 10, the day the FDIC closed SVB. For the low interest-rate risk group, we see a negative and significant abnormal return of only -3.0 percent on Thursday, Mar. 9 and only -3.5% on Monday, Mar. 13. Clearly, the market was differentiating between banks with high and low levels of interest-rate risk.

Figure 10 also plots abnormal returns for two groups of banks but based upon liquidity risk: those in the top (high liquidity risk) and bottom quartiles (low liquidity risk) of the ratio of uninsured deposits to total deposits. For the high liquidity-risk group, we see negative and highly significant abnormal returns of -6.5 percent on Thursday, Mar. 9 and of -11.5 percent on Monday, Mar. 13. There was a small but significant abnormal return of – 2.5 percent on Mar. 10, the day the FDIC closed SVB. For the low liquidity-risk group, we see a negative and significant abnormal return of only -2.5 percent on Thursday, Mar. 9, - 1.5 percent on Friday, Mar. 10, and

only -3.5% on Monday, Mar. 13. Clearly, the market also was differentiating between banks with high and low levels of liquidity risk.

Next, we conduct a "difference-in-differences" analysis of the abnormal returns during 90 trading days before through 15 trading days after the Mar. 8, 2023, loss announcement by Silicon Valley Bank. The dependent variable in models (1), (3), (5), and (7) is the BHC daily abnormal return estimated using the CAPM (multiplied by 100), while, in models (2), (4), (6), and (8), the dependent variable is the BHC daily abnormal return estimated using the Fama-French three-factor model (multiplied by 100). *Post SVB* equals one from March 9, 2023, through March 31, 2023, and zero before this period.

In columns (1) and (2), the focal explanatory variable is *High Int Risk*, which equals one if the repricing maturity of the bank holding company security portfolio was above the median of all bank holding companies, zero otherwise (based upon December 31, 2022, Call Report data). We find no significant effects of *High Unrealized Loss* on abnormal returns, either before or after the failure of SVB.

In columns (3) and (4), the focal explanatory variable is *High Uninsured Dep*, which equals one if the percentage of uninsured deposits of the bank holding company security portfolio was above the median of all bank holding companies, zero otherwise (based upon December 31, 2022, Call Report data). We find strong and statistically significant negative effects for *High-Uninsured-Dep* both before and after SVB's failure, with the post-SVB effect almost four times as large as the pre-SVB effect.

In columns (5) and (6), the focal explanatory variable is *High Unrealized Loss*, which equals one if the repricing maturity of the bank holding company security portfolio was above the median of all bank holding companies, zero otherwise (based upon December 31, 2022, Call

Report data). As with *High Int Risk*, we find no significant effects of *High Unrealized Loss* on abnormal returns, either before or after the failure of SVB.

In columns (7) and (8), we include both *High-Int-Risk* and *High-Uninsured-Dep*. When both are included, we find no significant effect for *High-Int-Risk* either before or after SVB's failure but continue to find significant negative effects for *High-Uninsured-Dep* both before and after SVB's failure, with the post-SVB effect almost four times as large and the pre-SVB effect.

In summary, we find no evidence that equity-market investors priced interest-rate risk in their reactions to the failure of SVB but did price banks' exposures to uninsured deposits, especially during the period after SVB's failure.

6. Summary and Conclusions

The bank-related events of the spring of 2023 – when three medium-sized commercial banks in the United States were closed by prudential regulators, amid concerns about depositor runs and contagion and with substantial costs to the Federal Deposit Insurance Corporation (FDIC) – have focused policy attention on U.S. commercial banks. We quantify the losses that resulted due to the interest-rate risks that many commercial banks have undertaken and the embedded securities losses on these banks' balance sheets. These losses were the immediate consequence of the sharp increase in interest rates that began in the spring of 2022. We ask whether banks that specialize in commercial real estate lending also suffer from heavy exposure to interest rate losses on their securities' portfolio, which has consequences for their ability to extend loans in the distressed commercial real estate sector.

We focus first on the embedded securities losses on banks' balance sheets as of mid-2023. Using Call Report data, we show that these losses are positively associated with banks'

holdings of residential mortgage-backed securities (RMBS) and of Treasury securities – but the losses are much more strongly associated (by a factor of 2-to-1 for all banks) with the former than with the latter. In essence, the banks' efforts at "reaching for yield" and the consequent securities losses took place through banks' holdings of both kinds of securities – but that the longer durations (and higher initial yields) of RMBS translated into losses per dollar of holdings that were twice the losses on Treasuries. These losses rose with the FOMC announcements of increases in the Federal Funds rate. Using daily stock price return data, we test for whether markets recognized the greater losses of the banks that were heavily exposed to securities with embedded interest rate risk. We test for whether the major decline in bank stock values that occurred on March 8, 2023,[9] reflected the disproportionate losses of banks heavily exposed to interest-rate risk as well as to withdrawals by uninsured depositors. We discuss policy implications for banks' holdings of residential mortgage-backed securities and the role for regulation in the absence of market discipline.

The banking problems of 2023 are – at least thus far – not a rerun of the banking difficulties of the late 1980s and early 1990s nor of the banking problems of the late 2000s and early 2010s. Those earlier problems for the banking system were based on problems of credit risk – especially related to commercial real estate loans of various kinds.

Instead, the current problems are reminiscent of – as the title of our paper indicates – the interest-rate risk problems of the S&L industry of the late 1970s and early 1980s: Too many banks in the early 2020s invested heavily in long-dated securities – especially RMBS and municipal securities – and then suffered large losses (albeit largely unrecognized in their formal financial statements) as a consequence of the general increase in interest rates that began in

[9] When SVB first announced losses, which led to two days of massive depositor runs and the bank's failure on March 10.

March 2022.[10] What also emerges from our analysis is that banks' CMBS investments – while contributing to those unrealized securities losses – have not played a major role in those losses. It is also worth noting that banks' direct commercial real estate lending was substantially larger (as a percentage of assets) for the banks that showed smaller unrecognized securities losses than for the banks with larger losses.[11]

There are at least three important policy lessons for prudential regulation of banks that follow from our analyses: (1) dealing with uninsured deposits, (2) addressing interest-rate risk, and (3) addressing deficiencies in financial reporting.

Dealing with uninsured deposits. Prudential regulation must come to terms with the current reality that approximately 40% of bank deposits are uninsured. This is roughly double the percentage level that prevailed in the early 1990s. Uninsured deposits may be a stable source of funding for the very large banks in the U.S. system that are perceived to be "too big to fail". But, as the experience of SVB in March of 2023 revealed, uninsured deposits can be a source of instability and of potential contagion for even sizable banks that are below that highest tier.

Further, as our diff-in-diff event study results in Table 5 indicate, after SVB's failure the shareholders of publicly traded banks became sensitized to the risks that the uninsured deposits in these banks embody. Such sensitivity is likely to carry over to contagion fears in these banks – as well as to fears by the uninsured depositors in smaller banks (that are not publicly traded and hence are not in the sample of banks in Table 5).

[10] It is worth noting that the S&Ls of the late 1970s were largely forced by regulation into their interest rate problems, since there were few allowed alternatives to long-term fixed-rate residential mortgages; see, e.g., White (1991). By contrast, the banks' decisions to invest the deposit inflows of 2020 and 2021 in long-dated securities was entirely voluntary (and, until March 2023, unrestrained by prudential regulators).

[11] As we noted above, however, there may well be unrecognized losses on banks' commercial real estate loans that are not required to be reported. Also, the generally weakened financial condition of the commercial real estate sector as of late 2023 – especially in urban areas – may well manifest itself in credit losses for banks in 2024 and after.

For the short run, greater supervisory attention to banks' uninsured deposits and their need for greater liquidity and higher capital so as to address the flight-risks that uninsured deposits pose is warranted. Over the longer run, liquidity and capital levels that are sensitive to uninsured deposits need to be embedded in formal bank regulatory requirements.[12]

There is also a need to revisit the larger question of the structure of deposit insurance in the U.S. banking system. This would include, for example, an examination of whether the deposit accounts by enterprises (which need relatively large deposit amounts so as to meet their payroll and accounts-payable needs) should be insured at different levels than apply to individuals' accounts. And such a re-evaluation must specifically address the negative externality that uninsured deposit flight-risks and contagion create.[13]

Fortunately, as of the spring of 2024, there have not been any new instances of uninsured deposit contagion – runs – since the SVB experience. It is far from clear that the banking system's "luck" will continue to hold – especially since (as we noted above) the banking system (especially small and medium-size banks) are likely to experience substantial losses on commercial real estate loans over the next few years. Addressing the problems that are associated with uninsured deposits in the current, more benign environment is surely a better route than dealing with them in the middle of a serious bout of contagion.[14]

[12] As of the spring of 2024, the U.S. bank regulators have a massive proposal outstanding – the "Basel III Endgame" – for revised regulation. It is too soon to tell what will be the final version of these proposed revisions.
[13] This topic requires far more attention than can be provided in this paper. A good place to start is the FDIC's (2023) recent report: "Options for Deposit Insurance Reform".
[14] In this vein, we offer the following aphorism: "The best time to fix the roof is when the sun is shining."

Addressing interest rate risk. Interest rate risk is too important to be left solely to supervisory discretion. It was massive interest rate risk that was SVB's fundamental undoing. And, as we have documented above, the massive unrealized security losses that have been present in the U.S. banking system since early 2022 are indicative of the large interest rate "bets" that U.S. banks made in the low interest rate environment of 2020 and 2021 – without (apparently) arousing substantial supervisory concerns.[15] Further, as McPhail et al. (2023) show, U.S. banks are not using swaps for offsetting their interest rate risks.

As we noted above, U.S. bank regulators currently have outstanding a proposed major revision of prudential regulations. We can only hope that more formal regulatory attention to interest rate risk will be one of the final outcomes of this revision.

Addressing deficiencies in financial reporting. Any prudential regulatory system must focus on the viability – and thus, ultimately, the solvency – of the banks that are being regulated. The measurement of that solvency – essentially, whether the bank has a positive net worth[16] – is wholly dependent on the accounting system that is used.

The standard accounting system that is at the heart of U.S. prudential regulation (and is used more widely for all publicly traded companies' financial accounts) is U.S. "generally accepted accounting principles" (GAAP). GAAP is fundamentally a backward-looking, original-cost based information system. It is generally not focused on attempts to provide current-based measures of asset and liability values.

[15] And the unrealized securities losses are a substantial understatement of the losses that banks have experienced on their longer-term loans more generally; see Jiang et al. (2023).
[16] As a first approximation, a bank's "capital" is its net worth; so, a solvent bank has a positive level of capital.

In the early 1990s, in the aftermath of the S&L debacle of the previous decade, there were efforts to bring the current values of financial instruments that could be readily valued (such as securities, but also residential mortgages) into GAAP and thus into bank prudential regulation. Bank executives lobbied heavily against these efforts; and eventually a compromise was reached, which involved incomplete inclusion of current values for traded debt securities.[17]

This incomplete inclusion has meant that banks – in their publicly reported balance sheets and in their calculations of their "capital" for regulatory purposes – can ignore current values and report historical values if the bank declares that it has no intention of selling the security before it matures.[18] It was this kind of practice that allowed SVB to portray itself as well capitalized (despite its embedded losses on its long-term securities holdings) – both on its publicly reported balance sheet and on its regulatory capital – until a few days before it was closed by the FDIC.

This GAAP system does not serve the bank prudential regulatory system well. Even if bank supervisors "know" better – that an apparently solvent bank's balance sheet and regulatory capital fail to reflect embedded losses and thus that the bank is not in as strong a position as it is portraying (and may even be insolvent, as was true for SVB from the third quarter of 2022 onward), supervisors may well feel constrained by the apparent health of the bank in question. And even just "seeing" the apparent health of this bank may color a supervisor's perspective.

The current GAAP compromise presumption for securities should be reversed: Current values for securities should be reported on banks' balance sheets and for regulatory capital purposes – and the bank should report its historical values elsewhere in its financial statements.

[17] More details on the compromise can be found in, for example, Kim et al. (2023).
[18] However, as part of the compromise, the current values must be reported in a publicly traded bank's financial statement – but not in the formally reported balance sheet or in the calculation of regulatory capital. The compromise is yet more convoluted for securities that are "available for sale."

Not only would this reversal of the value "presumption" be far more valuable for bank supervisors, but it may also help address the interest rate risk issue that we discussed above: If a bank's senior managers know that the consequences of future interest rate increases for currently purchased long-dated securities – future value decreases – will be reflected on their future balance sheets and their regulatory capital, they may be more reluctant to engage in that interest rate risk in the first place.

In a similar spirit, we suggest additional improvements in financial reporting that will help supervisors address the prudential problems that we have discussed above as well as potentially deter senior bank managers from exacerbating these problems:

- Require small banks (those under $1B in assets) to report their uninsured deposits (which is currently not required).
- There should be more "buckets" – more granularity – in banks' maturity/repricing information for long-dated assets – especially for residential mortgages.

As a corollary to better financial reporting, the financial reports themselves should be available regularly to bank regulators – and to the public – on a more frequent basis. In the electronic age, it is anomalous that bank "call reports" are still available on only a quarterly basis – and even then, with a 50–60-day lag. Ideally, daily close-of-business reports – as is required for U.S. mutual funds – would be the norm. More realistically – at least for now – monthly reporting (and a shorter lag) should be the norm.

There are also important ways that financial markets themselves can become more sensitive to the interest-rate risks that are undertaken by banks – which could enhance the role of markets in disciplining bank managements and thereby supplement regulatory measures. We

believe that the improved information/reporting suggestions that we have advanced above would help financial markets better monitor the banks to which they provide finance.

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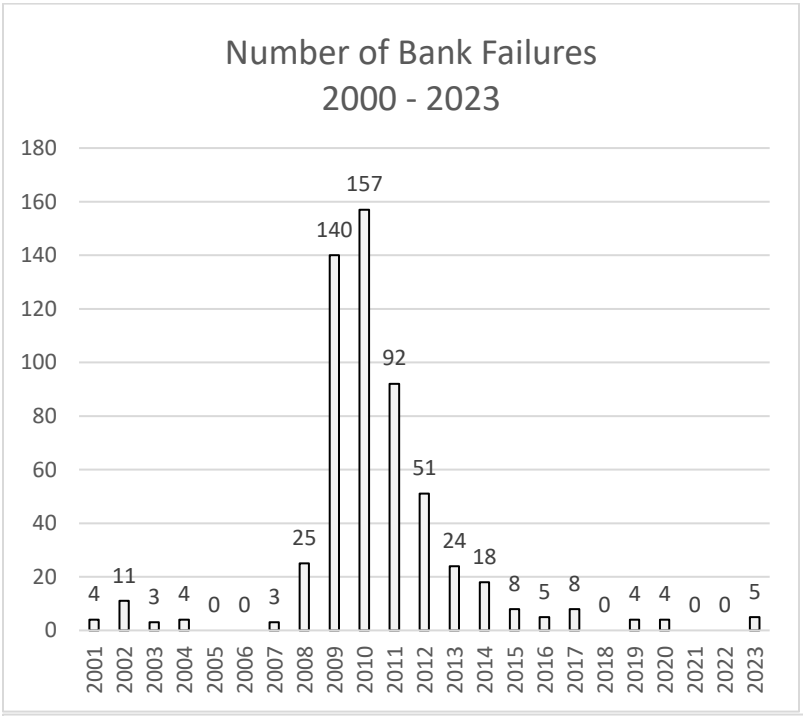
Tables and Figures

Figure 1:
Number and Assets of Failed U.S. Commercial Banks
2000 - 2023



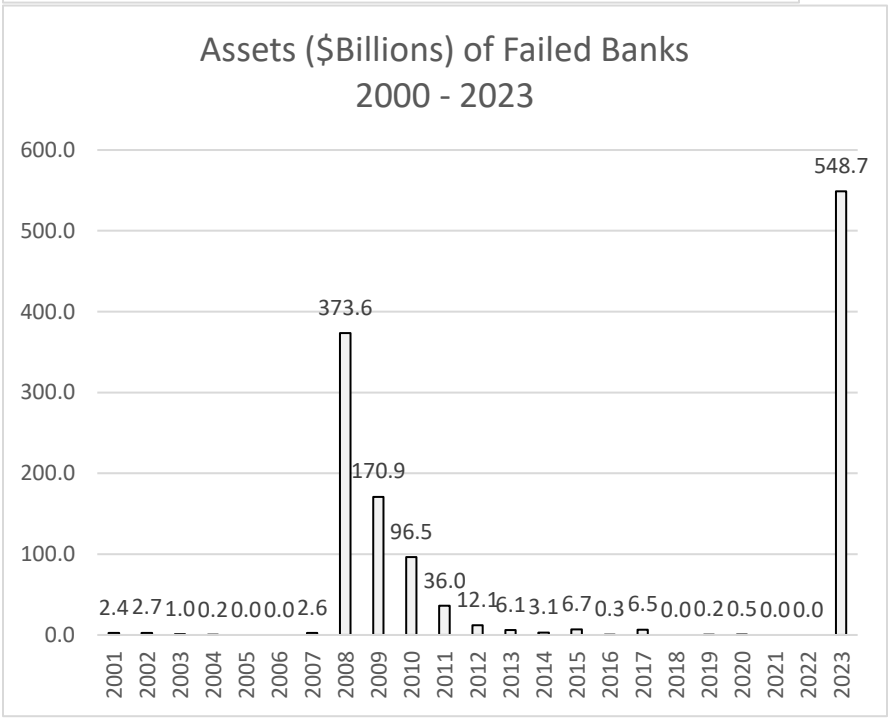


Figure 2:
Annual U.S. Federal Deficit/Surplus
1980 - 2023

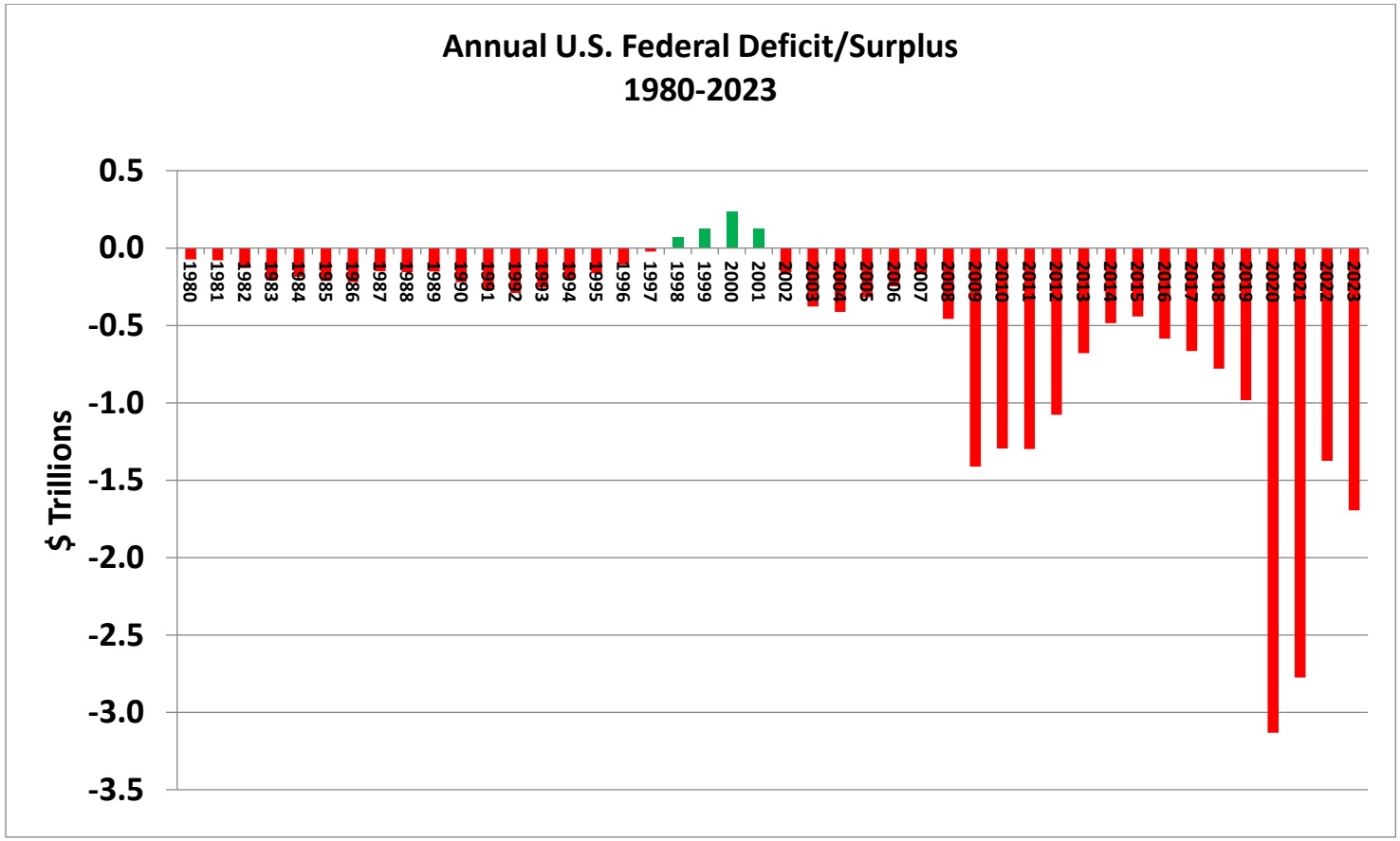


Figure 3:
Annual Change in Deposits and Securities held by U.S. Commercial Banks
2011-2022.

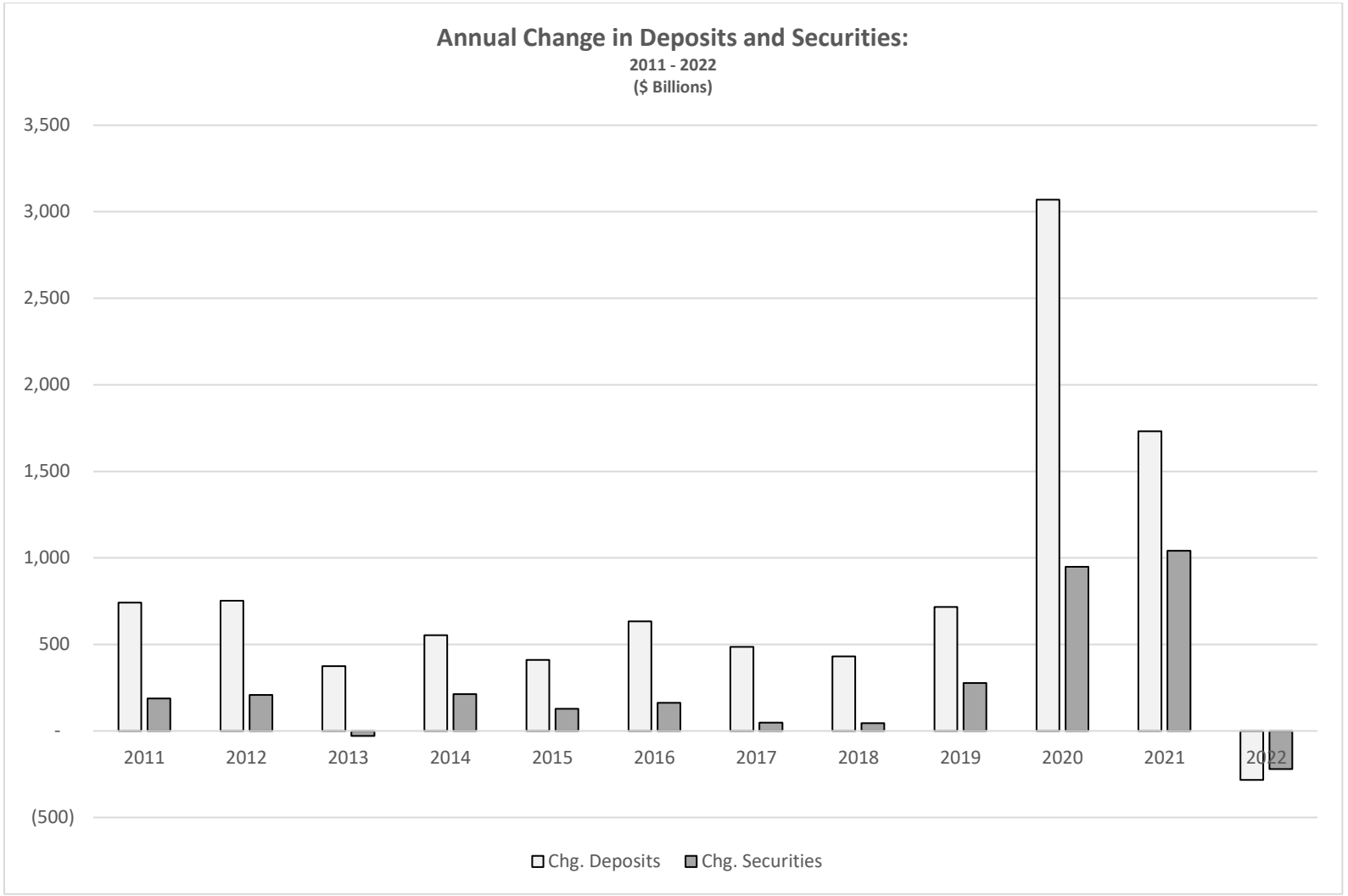


Figure 4:
Annual CPI Inflation Rate
1980 - 2023

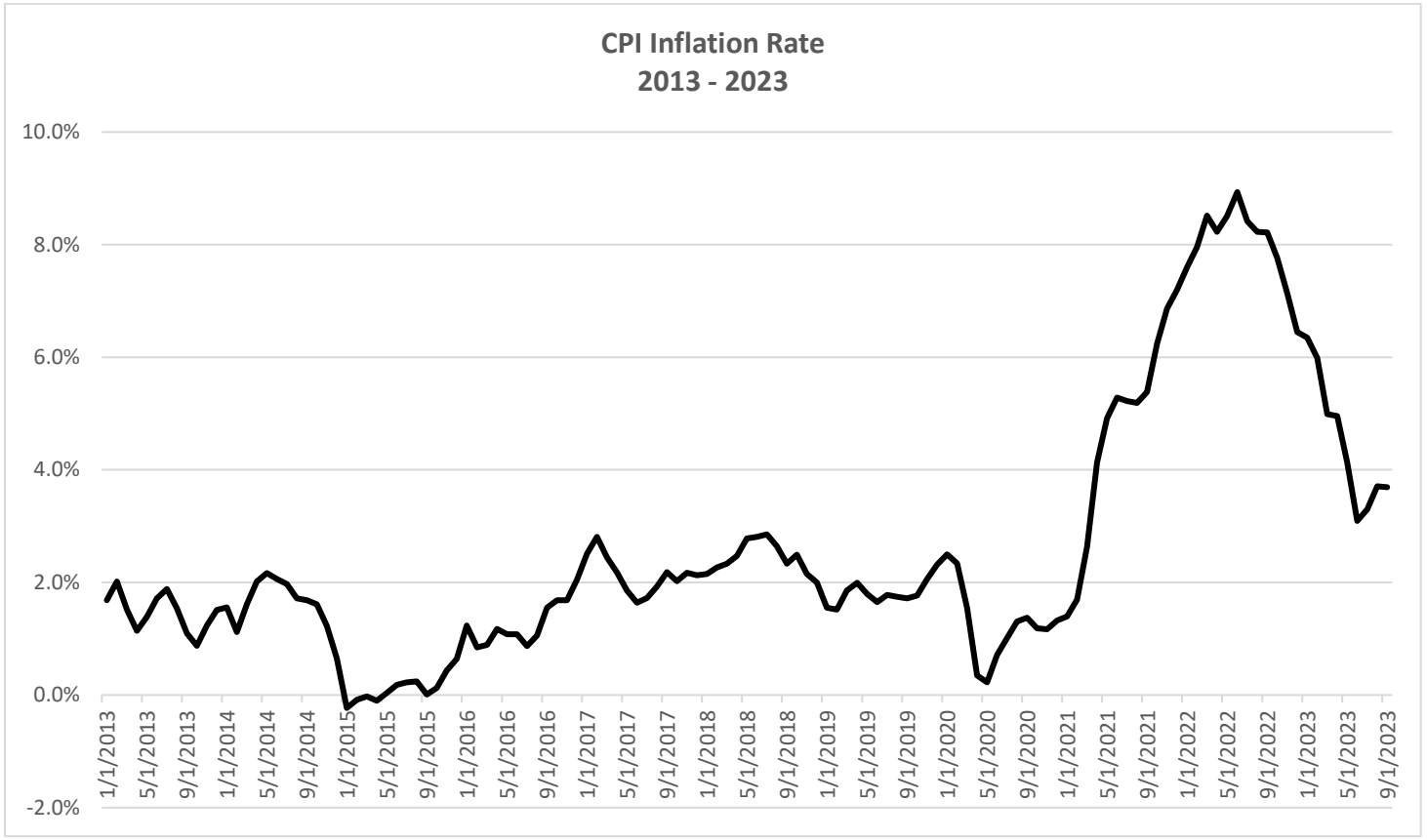
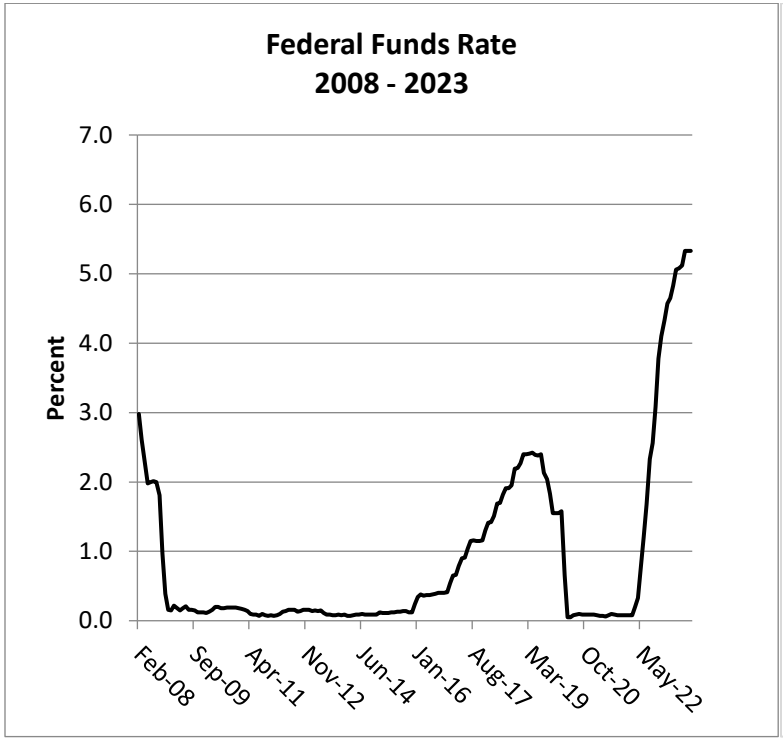


Figure 5:
U.S. Interest Rates

Panel A
Federal Funds Rate
2008 – 2023



Panel B
10-Year Treasury Bond Yield
2013 - 2023

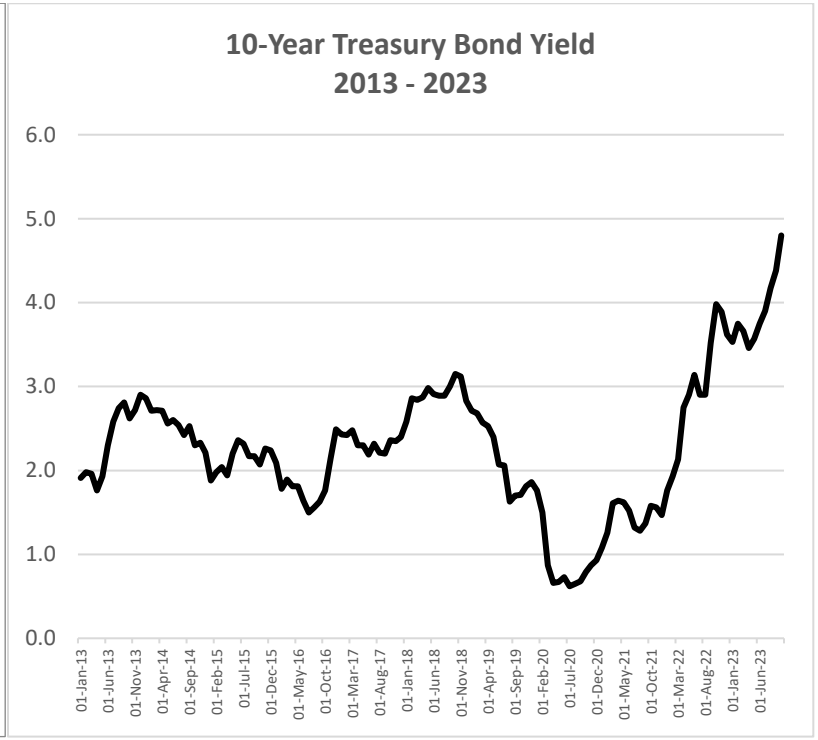
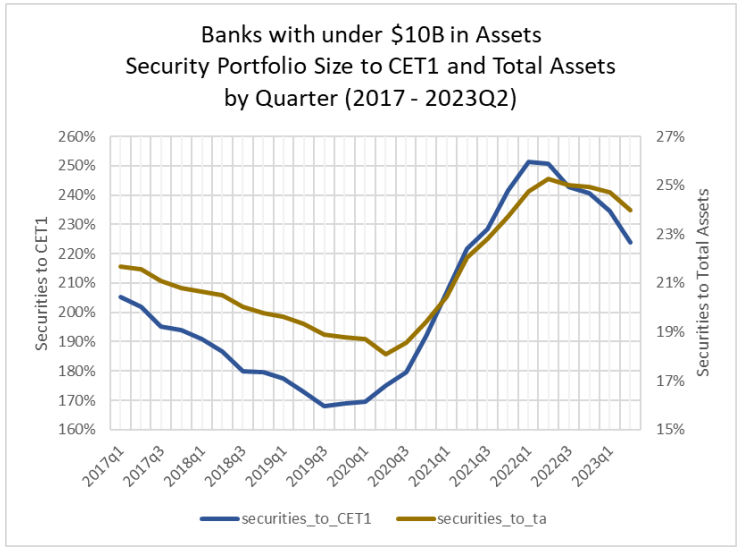
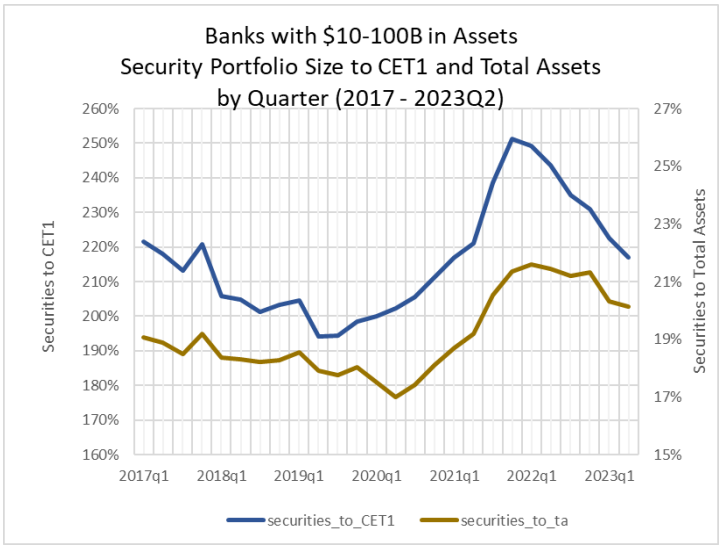


Figure 6:
Bank Securities Portfolio Size as a Percentage of CET1 and of Total Assets
By Bank Size

Panel A:



Panel B:



Panel C:

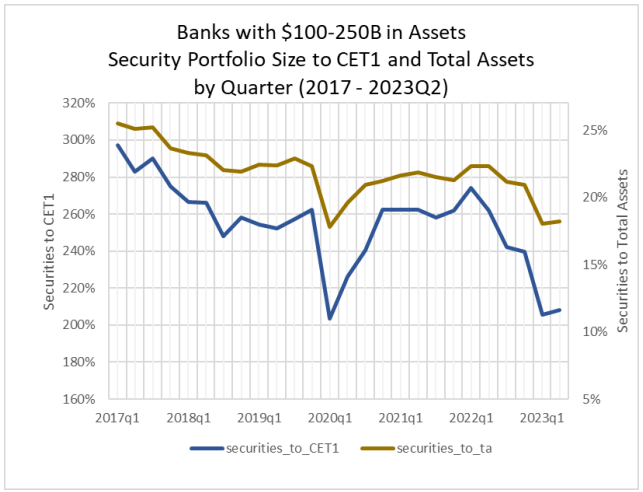
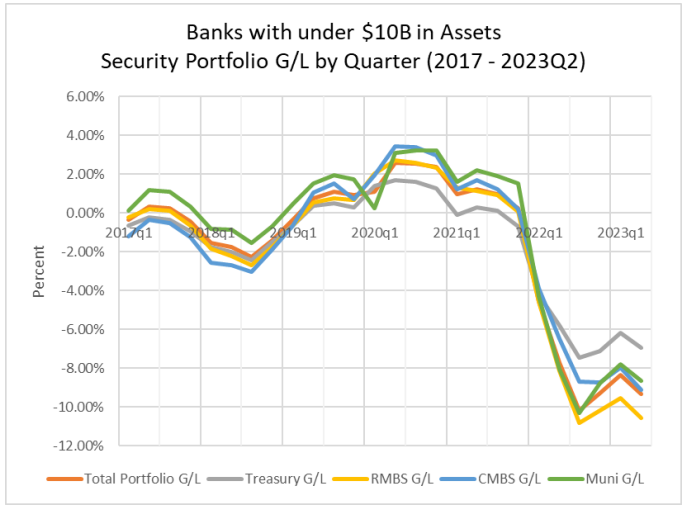
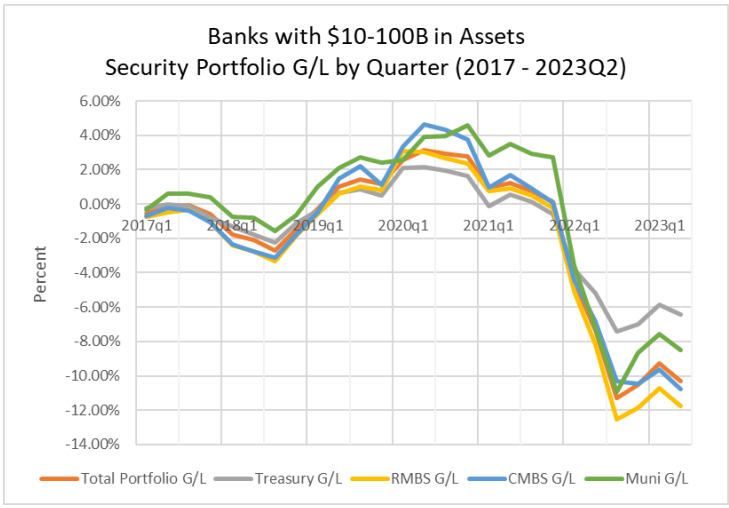


Figure 7:
Percentage Gain/Loss on Bank Securities Portfolio
By Bank Size

Panel A:



Panel B:



Panel C:

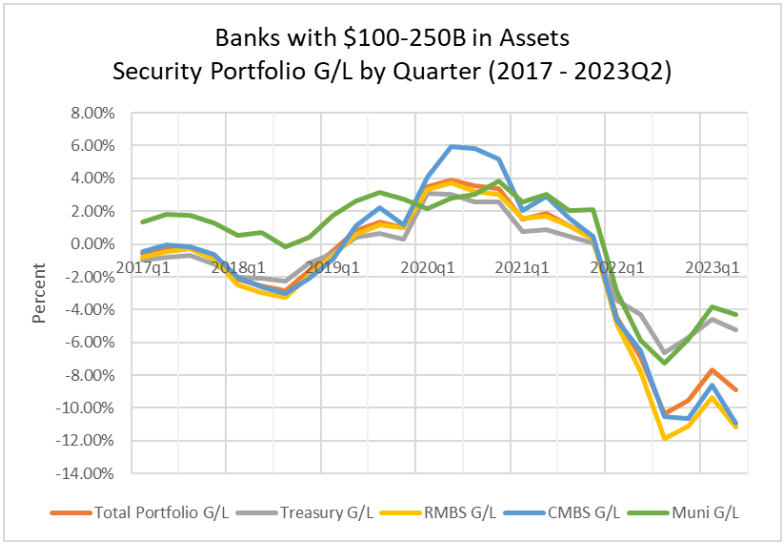


Figure 8:

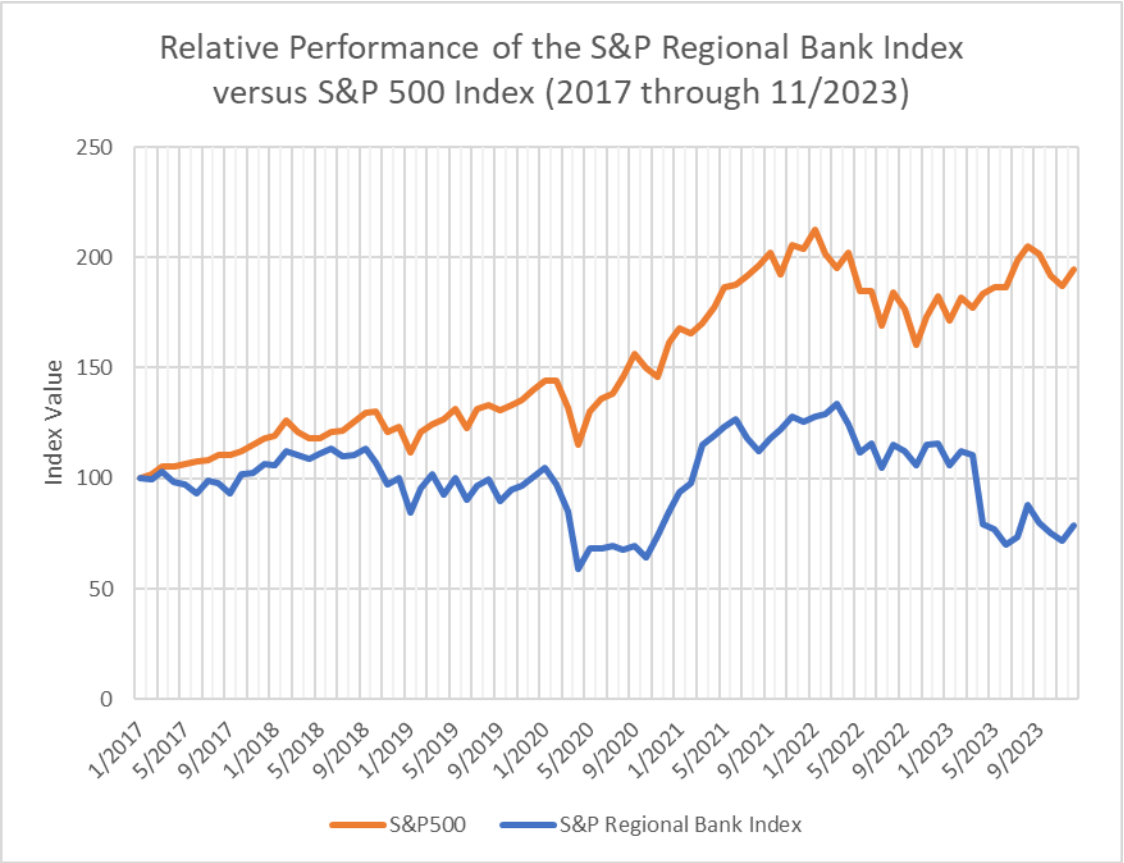


Figure 9:
Average daily abnormal returns of Bank Holding Companies (BHCs)
with high and low interest-rate risk in their security portfolios.

High (low) interest-rate risk BHCs are estimated using the top (bottom) quartile of security repricing maturities reported by BHCs for the fourth quarter of 2022. Average abnormal returns are estimated using a market model. On March 8th, 2023, Silicon Valley Bank announced a $1.8 billion loss on the sale of securities, including the Treasury and mortgage bonds, which had lost significant value over the previous year due to an aggressive series of interest rate hikes at the Federal Reserve. The FDIC closed SVB closed on March 10th, 2023.

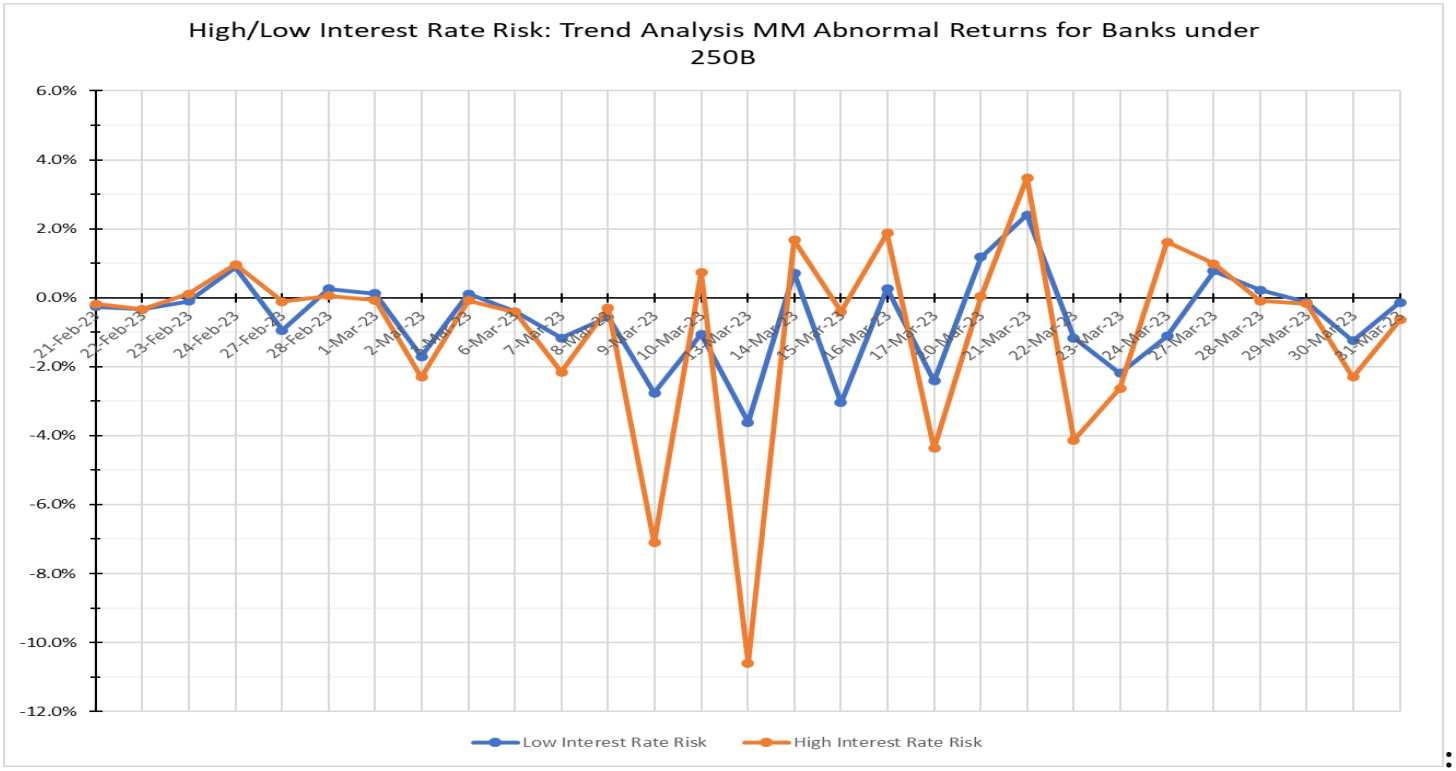


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Figure 10:
Average daily abnormal returns of Bank Holding Companies (BHCs)
with high and low liquidity risk in their security portfolios.

High (low) and low liquidity-risk BHCs are estimated using the top (bottom) quartile of the ratio of uninsured deposits to total deposits reported by BHCs for the fourth quarter of 2022. Low uninsured deposits BHCs are those in the bottom quartile. Average abnormal returns are estimated using a market model. On March 8th, 2023, Silicon Valley Bank announced a $1.8 billion loss on the sale of securities, including the Treasury and mortgage bonds, which had lost significant value over the previous year due to an aggressive series of interest rate hikes at the Federal Reserve. The FDIC closed SVB closed on March 10th, 2023.

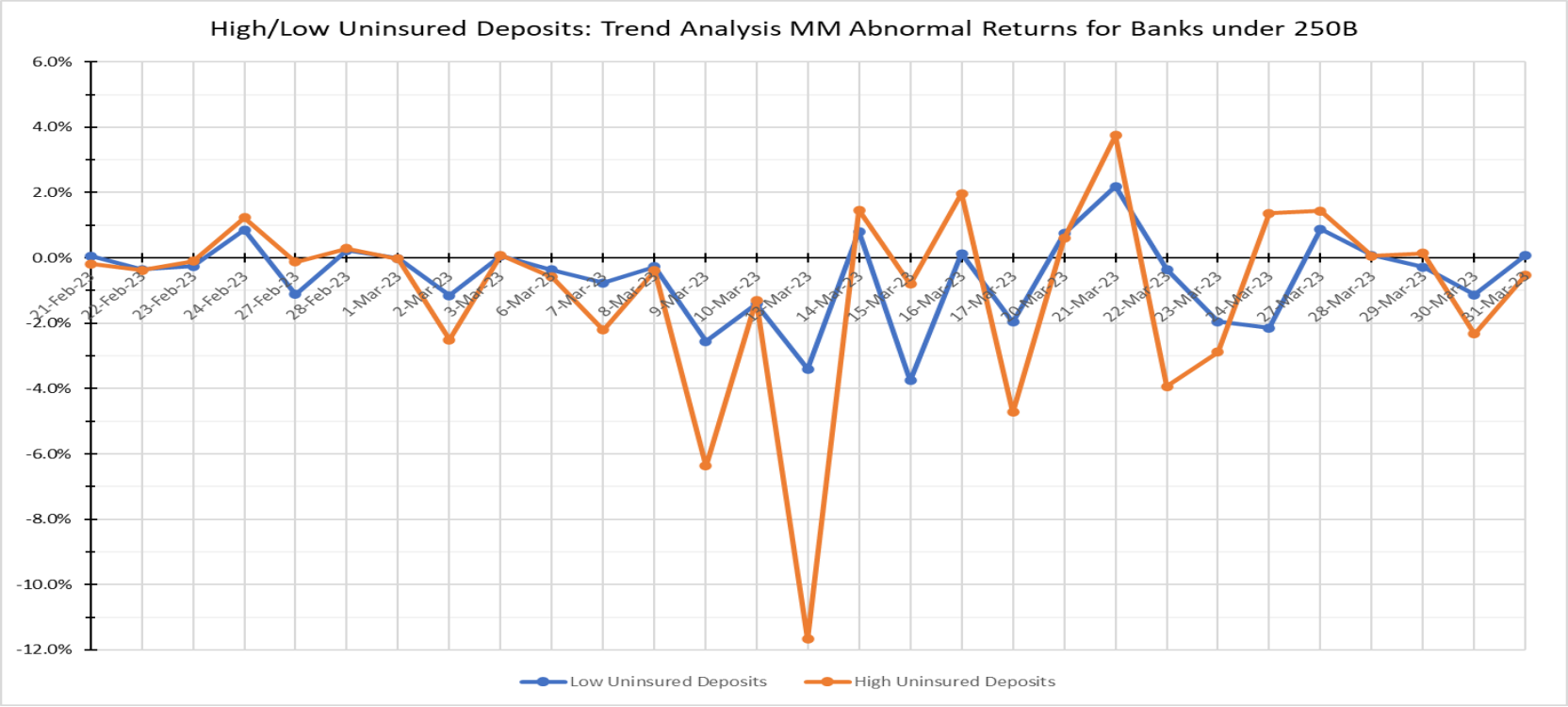

Table 1:
Descriptive Statistics

This table shows descriptive statistics for the following variables. **seclossta** is the ratio of unrealized securities losses (expressed as a positive value) to total assets. **govsecta** is the ratio of government (Treasury and municipal) securities to total assets. **treasecta** is the ratio of Treasury securities to total assets. **munisecta** is the ratio of municipal government securities to total assets. **rmbsta** is the ratio of residential mortgage-backed securities to total assets. **cmbsta** is the ratio of commercial mortgage-backed securities to total assets. **m14ta** is the ratio of 1-4 family residential mortgages to total assets. **creta** is the ratio of nonfarm nonresidential mortgages to total assets. **te_ta** is the ratio of total equity capital to total assets. **cet1ta** is the ratio of common-equity Tier 1 capital to total assets. These statistics are based upon quarterly financial data reported by 4,697 U.S. commercial banks for Q2 2023.

Variable	Label	Obs.	Mean	Std. Error	Min	p25	p50	p75	Max
seclossta	**Securities Losses to Assets**	4,697	0.025	0.000	0.000	0.008	0.020	0.036	0.189
govsecta	**Govt. Securities to Assets**	4,697	0.158	0.002	0.000	0.049	0.125	0.229	1.037
treasecta	**Treasury Securities to Assets**	4,697	0.082	0.001	0.000	0.013	0.046	0.116	1.037
munisecta	**Municipal Securities to Assets**	4,697	0.076	0.001	0.000	0.005	0.040	0.115	0.784
rmbsta	**Residental MBS to Assets**	4,697	0.074	0.001	0.000	0.005	0.047	0.107	0.814
cmbsta	**CRE MBS to Assets**	4,697	0.010	0.000	0.000	0.000	0.000	0.009	0.520
m14ta	**Residential Mortgages to Assets**	4,697	0.172	0.002	0.000	0.070	0.138	0.235	0.909
creta	**CRE Mortgages to Assets**	4,697	0.159	0.002	0.000	0.063	0.141	0.232	0.767
te_ta	**Total Equity Capital to Assets**	4,697	0.113	0.002	-0.048	0.075	0.093	0.115	1.000
cet1ta	**CET1 Capital to Assets**	4,697	0.127	0.001	0.044	0.093	0.105	0.126	1.040

Table 2:
Descriptive Statistics by Ratio of Securities Losses to Assets

This table shows descriptive statistics and differences in means of banks with below and above median securities losses (as a percentage of total assets) for the following variables. **seclossta** is the ratio of unrealized securities losses (expressed as a positive value) to total assets. **govsecta** is the ratio of government (Treasury and municipal) securities to total assets. **treasecta** is the ratio of Treasury securities to total assets. **munisecta** is the ratio of municipal government securities to total assets. **rmbsta** is the ratio of residential mortgage-backed securities to total assets. **cmbsta** is the ratio of commercial mortgage-backed securities to total assets. **m14ta** is the ratio of 1-4 family residential mortgages to total assets. **creta** is the ratio of nonfarm nonresidential mortgages to total assets. **te_ta** is the ratio of total equity capital to total assets. **cet1ta** is the ratio of common-equity Tier 1 capital to total assets. These statistics are based upon quarterly financial data reported by 4,697 U.S. commercial banks for Q2 2023.

		Securities Losses to Assets						
		Low		High		Difference		
Variable	Label	Mean	Std.Error	Mean	Std. Error	in Means	t-Statistic	
seclossta	Securities Losses to Assets	0.009	0.0001	0.042	0.0004	-0.033	-75.30	***
govsecta	Govt. Securities to Assets	0.091	0.0020	0.224	0.0030	-0.133	-36.86	***
treasecta	Treasury Securities to Assets	0.061	0.0017	0.103	0.0024	-0.042	-14.45	***
munisecta	Municipal Securities to Assets	0.031	0.0010	0.121	0.0023	-0.091	-36.36	***
rmbsta	Residental MBS to Assets	0.030	0.0008	0.118	0.0022	-0.088	-37.90	***
cmbsta	CRE MBS to Assets	0.004	0.0003	0.016	0.0007	-0.011	-16.08	***
m14ta	Residential Mortgages to Assets	0.192	0.0034	0.152	0.0024	0.040	9.48	***
creta	CRE Mortgages to Assets	0.184	0.0028	0.135	0.0020	0.049	14.26	***
te_ta	Total Equity Capital to Assets	0.136	0.0028	0.089	0.0014	0.048	15.32	***
cet1ta	CET1 Capital to Assets	0.137	0.0026	0.117	0.0013	0.020	6.83	***

Table 3:
Correlation Matrix

This table shows the correlation coefficients for the following variables. **seclossta** is the ratio of unrealized securities losses (expressed as a positive value) to total assets. **govsecta** is the ratio of government (Treasury and municipal) securities to total assets. **treasecta** is the ratio of Treasury securities to total assets. **munisecta** is the ratio of municipal government securities to total assets. **rmbsta** is the ratio of residential mortgage-backed securities to total assets. **cmbsta** is the ratio of commercial mortgage-backed securities to total assets. **m14ta** is the ratio of 1-4 family residential mortgages to total assets. **creta** is the ratio of nonfarm nonresidential mortgages to total assets. **te_ta** is the ratio of total equity capital to total assets. **cet1ta** is the ratio of common-equity Tier 1 capital to total assets. These correlations are based upon quarterly financial data reported by 4,697 U.S. commercial banks for Q2 2023.

		seclossta	govsecta	treasecta	munisecta	rmbsta	cmbsta	m14ta	creta	te_ta	cet1ta
seclossta	**Securities Losses to Assets**	1.000									
govsecta	**Govt. Securities to Assets**	0.578	1.000								
treasecta	**Treasury Securities to Assets**	0.220	0.725	1.000							
munisecta	**Municipal Securities to Assets**	0.606	0.683	-0.008	1.000						
rmbsta	**Residental MBS to Assets**	0.575	-0.026	-0.154	0.126	1.000					
cmbsta	**CRE MBS to Assets**	0.257	-0.023	-0.090	0.061	0.210	1.000				
m14ta	**Residential Mortgages to Assets**	-0.168	-0.235	-0.153	-0.179	-0.107	-0.088	1.000			
creta	**CRE Mortgages to Assets**	-0.252	-0.369	-0.256	-0.264	-0.120	-0.004	-0.147	1.000		
te_ta	**Total Equity Capital to Assets**	-0.241	-0.077	0.044	-0.159	-0.131	-0.082	-0.105	-0.152	1.000	
cet1ta	**CET1 Capital to Assets**	-0.078	0.037	0.086	-0.037	-0.039	-0.044	-0.128	-0.202	0.963	1.000

Table 4:
Regression Analysis

This table shows the results from a series of OLS regressions where the dependent variable is **seclossta,** which is the ratio of unrealized securities losses (expressed as a positive value) to total assets. Explanatory variables include: **govsecta** is the ratio of government (Treasury and municipal) securities to total assets. **treasecta** is the ratio of Treasury securities to total assets. **munisecta** is the ratio of municipal government securities to total assets. **rmbsta** is the ratio of residential mortgage-backed securities to total assets. **cmbsta** is the ratio of commercial mortgage-backed securities to total assets. **m14ta** is the ratio of 1-4 family residential mortgages to total assets. **creta** is the ratio of nonfarm nonresidential mortgages to total assets. These regressions are based upon quarterly financial data reported by 4,697 U.S. commercial banks for Q2 2023. Explanatory variables are based upon quarterly financial data reported by 4,697 banks for Q4 2021, prior to the first interest rate hike. Statistics appear in parenthesis.
*, **, and *** indicate statistical significance at the 10, 5 and 1 percent levels, respectively.

Variable	Label	(1)	(2)	(3)	(4)	(5)	(6)	(7)
treasecta	Treasury Securities to Assets	0.0641***						0.0825***
		(17.88)						(38.95)
munisecta	Muni Securities to Assets		0.135***					0.121***
			(49.35)					(61.75)
rmbsta	RMBS to Assets			0.143***				0.132***
				(47.60)				(63.04)
cmbsta	CMBS to Assets				0.209***			0.103***
					(16.98)			(14.47)
m14ta	Res. Mortgages to Assets					-0.0305***		0.00296**
						(-12.46)		-2.08
creta	CRE Mortgages to Assets						-0.0544***	0.00365**
							(-18.96)	-1.96
	Constant	0.0216***	0.0147***	0.0149***	0.0231***	0.0299***	0.0332***	-0.00223**
		(57.07)	(43.45)	(43.44)	(68.06)	(61.41)	(64.13)	(-2.52)
	Observations	4,673	4,673	4,673	4,673	4,673	4,673	4,673
	R-squared	0.064	0.343	0.327	0.058	0.032	0.071	0.712

Table 5:

Difference-in-differences estimation of daily abnormal returns during the first quarter of 2023.

The dependent variable in models (1), (3), (5), and (7) is the BHC daily abnormal return using the CAPM (multiplied by 100). The dependent variable in models (2), (4), (6), and (8) is the daily abnormal return using the Fama-French three-factor model (multiplied by 100). *High Int Risk* equals one if the repricing maturity of the bank holding company security portfolio was above the median of all bank holding companies, zero otherwise as of December 31, 2022. *High Uninsured* equals one if the percentage of uninsured deposits of the bank holding company security portfolio was above the median of all bank holding companies, zero otherwise as of December 31, 2022. *High Unrealized Losses* equals one if the repricing maturity of the bank holding company security portfolio was above the median of all bank holding companies, zero otherwise as of December 31, 2022. *Post SVB failure* equals on from March 9, 2023, through March 31, 2023, and zero before this period. t-Statistics are presented in parenthesis below the coefficients. Standard errors are clustered by bank holding company.
*, **, and *** indicate statistical significance at the 10, 5 and 1 percent levels, respectively.

High_Int_Risk ×Post SVB Failure	-8.84		-7.569										-11.09		-9.263	
	(-1.164)		(-1.010)										(-1.363)		(-1.149)	
High_Int_Risk	2.356		1.987										1.356		1.345	
	(0.87)		(0.78)										(0.47)		(0.49)	
High Uninsured x Post SVB					-25.069	***	-19.016	**					-24.572	***	-18.601	**
					(-2.990)		(-2.290)						(-2.990)		(-2.287)	
High Uninsured Dep					-6.555	**	-4.883	*					-6.619	**	-4.947	*
					(-2.308)		(-1.811)						(-2.312)		(-1.816)	
High Unrealized Loss x Post SVB									0.081		-0.359					
									(0.011)		(-0.048)					
High Unreal Losses									-3.411		-3.178					
									(-1.253)		(-1.241)					
Post SVB	-83.712	***	-63.033	***	-79.263	***	-59.645	***	-88.246	***	-66.698	***	-73.983	***	-55.234	***
	(-19.755)		(-14.868)		(-19.759)		(-14.230)		(-19.652)		(-15.051)		(-13.228)		(-9.418)	
Constant	-14.375	***	-6.987	***	-10.826	***	-4.037	*	-11.44	***	-4.358	**	-11.472	***	-4.677	**
	(-7.740)		(-4.045)		(-4.767)		(-1.873)		(-5.582)		(-2.210)		(-4.634)		(-2.030)	
Adjusted R-Squared	0.029		0.020		0.033		0.023		0.029		0.020		0.033		0.023	
Number of Observations	11,749		11,749		10,447		10,477		11,749		11,749		10,447		10,447	