SAMUEL G. HANSON
Harvard Business School and NBER

VICTORIA IVASHINA
Harvard Business School and NBER

LAURA NICOLAE
Harvard University

JEREMY C. STEIN
Harvard University and NBER

ADI SUNDERAM
Harvard Business School and NBER

DANIEL K. TARULLO
Harvard Law School and Brookings

The Evolution of Banking in the 21st Century: Evidence and Regulatory Implications[*]

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ABSTRACT: As revealed by the failures of three regional banks in the spring of 2023, bank runs are not a thing of the past. To inform the ongoing discussion of the appropriate regulatory response, we examine trends in the banking industry over the last twenty-five years. On the liability side of bank balance sheets, deposits—and especially uninsured deposits—have grown rapidly. On the asset side, there has been a notable shift away from the information-intensive lending traditionally associated with banks and towards longer-term securities such as MBS and long-term Treasuries. These trends appear to be related, in the sense that banks with the most rapid growth in deposits have seen the biggest declines in loans as a share of assets. Thus, while the banks that failed in early 2023 were arguably extreme cases, they reflect broader trends, especially among larger banks. We construct a simple model to help assess the main regulatory options to reduce the risk of destabilizing bank runs—expanding deposit insurance and strengthening liquidity regulation—and argue that the industry trends we document favor the latter option. Using the model, we offer some design considerations for modifying the Liquidity Coverage Ratio so as to require banks to pre-position sufficient collateral—largely in the form of short-term government securities—at the Federal Reserve's Discount Window to ensure they have enough liquidity to withstand a run on their uninsured deposits. We also comment briefly on some other regulatory implications of our findings, including for interest rate risk regulation and merger policy.

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I. Introduction

The late winter and early spring of 2023 saw three of the four largest bank failures in U.S. history, those of Silicon Valley Bank, Signature Bank, and First Republic Bank, on March 10, March 12, and May 1, respectively. This dramatic episode, and the failures in bank regulation that it revealed, naturally led to calls for a variety of regulatory changes. While we believe that this instinct towards reform is well-motivated, in this paper we begin by taking several steps back. We try to sketch some of the broader forces that have been shaping the evolution of the banking industry, and of financial intermediation more generally, over the last quarter-century. Our premise in doing so is that only by understanding how the economics of the banking industry have evolved can one begin to think sensibly about how regulation might be best adapted.

We organize our analysis around the two fundamental pillars of banks' business model: (i) making information-intensive loans to borrowers who are risky and opaque; and (ii) providing deposit-taking and transactions services. We then ask how developments in these two areas have affected banks in different size categories: (i) the largest global banks, the so-called G-SIBs, who currently have assets over $700 billion;[1] (ii) regional banks that, for the sake of concreteness, we classify as having assets between $100 billion and $700 billion today; and (iii) smaller banks, who have assets less than $100 billion today.[2]

The idea that banks—and financial intermediaries more generally—create value on the asset side of their balance sheets by screening and monitoring borrowers is perhaps the most venerable and widely-accepted view in the academic literature. Diamond (1984) is the classic reference for this "asset-side" view of what makes banks special. However, the view that banks play a unique role in information-intensive lending has come under increasing pressure in recent decades, as non-bank institutions have steadily gained market share in lending to businesses. These non-bank players include securitization vehicles, mutual funds, and insurance companies who finance portions of syndicated loans—and, in more recent years, private-credit funds and business

[1] Eight U.S. bank holding companies currently qualify as Global Systemically Important Banks (G-SIBs): JPMorgan Chase, Bank of America, Citigroup, Wells Fargo, Goldman Sachs, Morgan Stanley, Bank of New York Mellon, and State Street. The first six of these institutions all have assets above $1 trillion. The two custodian banks— Bank of New York Mellon and State Street—have assets below $700 billion but are systemically important because of the central role they play in settling securities transactions.

[2] We recognize that there are no sharp dividing lines based on assets that can fully distinguish banks with different business models. So, for example, a number of banks with assets less than $100 billion might have business models similar to those of some banks with assets over $100 billion. However, we do not think that an effort at making finer-grained distinctions would noticeably change our basic conclusions.

development companies (BDCs) who lend to medium-sized firms. Moreover, it appears that the competition from private-credit funds and BDCs has been felt most acutely by regional banks. By contrast, the smaller community banks, which tend to specialize in lending to much smaller firms, have been less affected by the growth of non-bank intermediaries. [3]

Another branch of the literature, beginning with Gorton and Pennacchi (1991), emphasizes the value that banks create on the liability side of their balance sheets, via their deposit-taking franchises. There are two logically distinct mechanisms at work here. The first is that some agents in the economy prefer holding absolutely safe assets as a store of value, and that bank deposits are an especially good vehicle for providing this safety. Moreover, these same agents often tend to be sleepy or inattentive and will generally accept below-market rates on their deposits, perhaps partially in exchange for the amenities provided by their bank—friendly and accessible branch offices, and the like.[4]

A second source of value from banks' deposit-taking activities stems from their unique role in the payments system. In addition to being a safe store of value, bank deposits allow firms and households to transfer resources quickly and efficiently. A firm that uses its bank to handle transactions with its employees, suppliers, and customers on a daily basis is a concrete example of this transactional function.

One of the most striking developments that we document over the last quarter-century is a dramatic growth in the economy-wide ratio of bank deposits to GDP, with much of this growth coming from large uninsured deposits. Thus, very crudely put, the business of banking seems to be slowly moving away from a Diamond (1984) world and towards a Gorton-Pennacchi (1991) world. We reflect on some of the underlying causes of this deposit growth in what follows, though to be clear, we do not have a single encompassing explanation to offer. However, if one posits that the demand for payments services should scale roughly with GDP, the rapid growth in the ratio of deposits to GDP suggests that some of the action is coming from the safe-store-of-value motive, which might scale more naturally with wealth, rather than GDP.

Putting together these two trends—the migration of information-intensive business lending outside of the banking sector and the rapid growth of bank deposits—the inevitable consequence

[3] See Erel and Inozemtsev (2024) for an overview of the literature on the causes and consequences of the rise in non-bank lending.

[4] Note that to the extent that the value of a bank's deposit franchise comes from paying depositors less than the market rate (and adjusting for the cost of taking deposits), this is a private source of value, but not necessarily of social benefit.

is a shifting of banks' asset portfolios towards categories where there is less of a presumption that they have a unique comparative advantage. Specifically, and this is especially true for the larger banks that have been most impacted by competition from non-bank lenders, the share of securities in their portfolios has increased significantly in recent decades. These securities consist primarily of U.S. Treasuries and agency mortgage-backed securities (MBS) whose payments are insured by the government sponsored enterprises. Thus, these securities are free of credit risk, so the only risk that banks face in holding them is interest-rate risk. In this sense, the larger banks are beginning to look more like long-term bond mutual funds than they did at the beginning of the century, albeit bond funds that have uninsured liabilities that can be withdrawn on demand at par, rather than being equity financed. In what follows, we argue that this observation is of particular relevance when considering questions about whether and how regulators should modify deposit insurance coverage and bank liquidity regulation.

Of course, it can be artificial to frame things by simply contrasting theories whereby banks create value *either* on the asset side of their balance sheet *or* the liability side. There can be important synergies between the two sides of the balance sheet. For instance, in Diamond and Dybvig (1983) and Hanson, Shleifer, Stein, and Vishny (2015), banks can finance portfolios of illiquid loans more efficiently than other types of intermediaries so long as they can issue demand deposits that are not prone to destabilizing runs. With some liberties, this theory might be interpreted as warning that a failure to offer sufficiently broad deposit insurance coverage could interfere with the process of credit creation in the economy. This possibility highlights why it is critical to think about exactly what kinds of assets the marginal bank deposit is financing.

Alternatively, a synergy between the two sides of banks' balance sheets can arise if deposit-taking, and the resulting need to hold a buffer stock of high-quality liquid assets as well as the associated access to the central bank's lender of last resort function, give banks a balance-sheet based edge over non-bank intermediaries in offering on-demand lines of credit (Kashyap, Rajan and Stein (2002)). Consistent with this view, we show that the one area of corporate lending where banks have not lost ground to non-bank intermediaries is in providing loan commitments to firms.

In what follows, we explore both time-series and cross-sectional aspects of the above-mentioned trends in banks' deposit-taking and lending behavior. We then turn to some of the policy implications of these trends. Here we begin by developing—with the aid of a simple model—a normative perspective on the design of bank liquidity regulation.

The bank failures of early 2023 highlighted a dramatic vulnerability with respect to liquidity risk, created by the combination of rapid growth of uninsured deposits, and technological and social media innovations, which appear to have made bank runs more rapid and violent than ever before. As one extreme example, 94% of Silicon Valley Bank's (SVB) total deposits were uninsured on the eve of its failure. And 25% of SVB's deposits were withdrawn in a single day, forcing its closure by regulators. Moreover, had it opened for business the next day, SVB told regulators it expected to see withdrawals of more than twice that amount in the following 24 hours.

This episode lends urgency to the question of how such extreme run risk can best be mitigated going forward. Two broad categories of options are: (i) increasing the scope of deposit insurance, so that most deposits are insured and hence less likely to run; or (ii) subjecting uninsured deposits to tougher liquidity requirements so that the risk of runs poses a smaller threat to financial stability. Although both options are likely to deliver benefits in terms of mitigating run risk, they entail different costs. On the one hand, expanding deposit insurance would likely create additional moral hazard distortions, and expose taxpayers to greater losses. On the other, tougher liquidity requirements—i.e., requiring banks to hold a larger buffer stock of high-quality liquid assets to cover deposit withdrawals—might potentially crowd out some valuable information-intensive lending. The observation that, in both the time series and the cross section, the rapid growth in uninsured deposits has largely been used to fund growth in securities like MBS—and not in information-intensive lending—suggests that the costs of tougher liquidity requirements are lower, which inclines us to this latter option.

Specifically, we propose a regulatory change that would require banks with more than $100 billion in assets to back their uninsured deposits by pre-positioning collateral—largely in the form of short-term government securities—at the Federal Reserve's Discount Window. As we explain, the federal banking agencies could implement our proposed regulatory change by modifying current Liquidity Coverage Ratio (LCR) requirements.

Of course, to the extent we have correctly identified some of the key underlying trends that are changing the business of banking, there may be reason to adjust other regulatory policies beyond just the pressing case of liquidity requirements. We focus briefly on two of these. One has to do with the treatment of interest-rate risk in the regulatory capital regime. Currently, risk-based capital requirements do not account for the *ex ante* interest-rate risk on long-duration securities like Treasury bonds and MBS. Moreover, even *ex post*, mark-to-market losses on these securities

do not flow through to banks' regulatory capital, except for the largest G-SIBs. We argue that in a world where uninsured deposits make up a much larger share of banks' capital structure than in earlier decades, these policies need to be rethought.

Finally, we turn to merger policy. Our analysis suggests that the business model of regional banks may be particularly vulnerable to the broad forces that are likely to shape the banking industry in the coming years. Unlike the community banks, which focus on relationship lending to the smaller firms in the economy, regionals have lost a good chunk of their core business lending franchise to the non-bank sector. This leaves them disproportionately reliant on their deposit franchises for ongoing viability, at a time when the longer-run durability of these franchises also seems open to question. Moreover, the regional banks may not have sufficient economies of scale and scope to compete with the handful of the very largest banks as technological innovation and artificial intelligence become more and more vital to profitability. Mergers within the mid-sized regional sector might be one helpful mechanism in moving the process of consolidation along, while minimizing harmful medium-term effects on competition and financial stability.

II. The Growth of Bank Deposits

Looking at quarterly data from 1995Q4 to 2023Q2, Figure 1A plots the ratio of total deposits in U.S. depository institutions to GDP alongside the ratio of uninsured domestic deposits to total domestic deposits at FDIC-insured institutions.[5] We linearly interpolate the uninsured share of deposits from 2009Q4 to 2012Q4 to visually smooth over the effect of the Transaction Account Guarantee (TAG) program, which temporarily lowered the uninsured share by providing unlimited insurance coverage on transaction deposits in the wake of the 2008 global financial crisis.[6]As Figure 1A shows, deposits have grown rapidly relative to GDP over the past 30 years, with much of the growth coming from uninsured deposits. In 1995Q4, deposits were 49% of GDP and the uninsured share was 20%. As of 2023Q2, deposits are 75% of GDP and 39% of them are uninsured.

[5] To facilitate consistency in this section, our total deposit series in Figure 1A comes from the Financial Accounts of the U.S. and includes U.S.-chartered depository institutions, U.S. foreign banking offices, banks in U.S.-affiliated areas, and credit unions. If we focus on U.S.-chartered depository institutions—a universe that more closely matched the set of FDIC-insured institutions—the ratio of deposits to GDP rises from 41% in 1995Q4 to 63% in 2023Q2.

[6] The TAG program provided *unlimited* insurance on deposits held in noninterest-bearing transaction accounts for banks that chose to participate. The FDIC created this program in October 2008 using an emergency "systemic risk determination" and it was in effect until the end of 2010. In mid-2010, Congress enacted a similar program for all banks that remained in effect until the end of 2012.

Simply put, banks are much more deposit rich today than in past decades, but they are also far more exposed to the potential flightiness of uninsured deposits.[7]

This reliance on uninsured deposits is most pronounced for larger banks. As of 2023Q2, 30% of domestic deposits in smaller banks—those with assets under $100 billion—are uninsured. For banks with assets over $100 billion but that are not G-SIBs, the corresponding figure is 39%. And for the G-SIBs, it is 51%. Indeed, across the latter two categories, 27% of banks have an uninsured deposit share than exceeds 50%.[8]

To shed some light on the forces driving these trends, Figure 1B shows the evolution of a broader measure of "money-like" assets. Specifically, we decompose total deposits into the sum of checkable deposits and savings and time deposits. To arrive at our broader measure of money-like assets, we then add the sum of currency in circulation and money market mutual fund shares. While there are cyclical fluctuations in this broader measure (e.g., money-like assets tend to rise relative to GDP during recessions and financial market downturns), money-like assets have trended steadily upwards in recent decades, rising from 63% of GDP in 1995 to 107% of GDP in 2023Q2. Similarly, even though there are some noticeable cyclical shifts tied to the level of short-term interest rates, the relative shares of different money-like assets—checking deposits, savings and time deposits, money market fund shares, and currency—have been fairly stable over time.[9]

Next, using data from the Financial Accounts of the U.S., Figured 1C breaks down the holders of money-like assets. Consistent with the well-documented rise in corporate cash holdings (Bates, Kahl, and Stulz (2009) and Graham and Leary (2018)), the cash holdings of nonfinancial firms and non-bank financial institutions have grown noticeably relative to the households' cash

[7] The uninsured share was also quite high from the advent of the FDIC in 1934 through the 1970s. However, this was arguably because, adjusted for inflation, deposit insurance limits were much lower in those earlier decades. Although this relationship has broken down in recent years, historically there was a strong negative correlation between the uninsured share of deposits and the inflation-adjusted insurance limit. For instance, the uninsured share in the early 1960s was almost identical to the today's uninsured share. However, adjusted for inflation, the insurance limit in the early 1960s was only 38% of today's limit. Thus, what is historically anomalous is today's combination of a high uninsured share and a relatively generous insurance limit in inflation-adjusted terms.

[8] These figures are based on Call Report data. Using this data, we estimate that 41% of banks' deposits were uninsured in 2023Q2. The FDIC estimates that the uninsured share of domestic deposits was 39% in 2023Q2 (Figure 1A).

[9] When the Fed raises its short-term policy rate, the rates that banks pay on checking and savings deposits lag well behind other money market rates (which generally move in lock-step with the Fed's policy rate). Thus, when the Fed raises rates, savers tend to gradually substitute away from lower-yielding checking and savings accounts and towards higher-yielding time deposits and money market fund shares. Conversely, when the policy rate is low, lower-yielding checking and savings deposits tend to grow more rapidly than time deposits. See Dreschler, Savov, and Schnabl (2017).

holdings. Nonetheless, households still hold the lion's share of money-like assets, accounting for 61% of total cash holdings as of 2023Q2 as compared to 27% for nonfinancial and financial firms.

Notably, the quantity of deposits and other money-like assets, as well as the uninsured share of deposits, rose sharply following the onset of COVID-19 in 2020. Moreover, checking deposits have grown at record rates since 2020, while the growth in savings and time deposits has languished by comparison. Arguably, some of these recent shifts reflect the heightened precautionary motives associated with the pandemic and the fact that interest rates were at the zero lower bound. In addition, there is also clear evidence from account-level data at JPMorgan Chase that these abnormally large deposit balances are partially due to the outsized fiscal transfers to households during the pandemic.[10] Finally, Acharya and Rajan (2023) and Acharya, Chauhan, Rajan, and Steffen (2024) have argued that the Federal Reserve's quantitative easing (QE) policies have led to an expansion of uninsured deposit financing, as banks have had to turn to uninsured deposits to fund their much-increased holdings of reserves. Collectively, these factors arguably explain these notable pandemic-era shifts, all of which has begun to reverse in recent quarters. But Figure 1A makes clear that the upward trend in deposits-to-GDP, as well as the uninsured share, has been ongoing for decades, predating both the arrival at the zero-lower bound and the initiation of QE policies in 2008 as well as the onset of the pandemic in 2020.

With respect to the factors that underlie these longer-term trends, we do not have any clear-cut evidence to offer. As noted above, the growth in the ratio of deposits to GDP could reflect a safe-store-of-value motive, which might scale more naturally with wealth, rather than with GDP. Consistent with this view, while total deposits have been growing as a fraction of GDP, Figure 1D shows that households' holdings of deposits and other money-like assets have been quite stable relative to their total financial wealth, suggesting that households' portfolio allocation to money-like assets has been stable over time. Thus, the secular rise in the ratio of deposits-to-GDP is clearly linked to the secular growth in financial wealth relative to GDP. That said, investors' willingness to hold their safe assets in the form of bank deposits paying less than a market rate—rather than in money market fund accounts, for example—might have been greater, all else equal, due to the low level of interest rates the U.S. has experienced in recent decades.

[10] See https://www.jpmorganchase.com/institute/research/household-income-spending/household-pulse-cash-balances-through-March-2023.

Turning to the upward trend in the uninsured share of deposits, it stands to reason that the secular rise in household wealth inequality and the growth in corporate cash holdings play some role in driving this trend. However, in the absence of account-level data, it is difficult to say whether or not these are important contributing factors.

III. The Rise of Non-Bank Corporate Lending

Figure 2 uses data from Table L.103 of the Financial Accounts of the U.S. and presents two perspectives on the evolution of bank lending as a share of total credit to the nonfinancial corporate sector. The solid blue line in the figure shows the ratio of bank loans to non-financial businesses divided by total loans to these firms.[11] Importantly, the non-bank component of loans in the Financial Accounts data includes syndicated loans that are held by non-bank investors such as collateralized loan obligations (CLOs), mutual funds, insurance companies, and pension funds, but *does not include* lending originated by private credit funds and BDCs.[12] The dashed red line in the figure adds corporate bonds and other debt securities to the denominator, showing bank loans to nonfinancial corporations as a share of all forms of credit (again, excluding loans from private credit funds and BDCs as well as mortgages).

Even before accounting for private credit and BDCs, Figure 2 shows that banks currently provide a much smaller share of credit to nonfinancial corporations than they did at the turn of the century. As of 2023Q3, bank loans account for only 35% of total non-mortgage loans and just 13% of total non-mortgage credit to nonfinancial corporations, down from 57% and 23%, respectively, in 2000Q4. Naturally, banks also account for a similarly small fraction of the total growth in corporate credit over the past decade. From 2013Q4 to 2023Q3, bank loans to nonfinancial corporations grew by roughly $700 billion. By contrast, non-bank loans to nonfinancial corporations grew by $1.6 trillion and debt securities grew by almost $3.1trillion. Thus, bank loans account for 30% of the growth in total corporate loans and 13% of the growth in all corporate credit over the last decade.

[11] We exclude commercial mortgages from both the numerator and denominator since the Financial Accounts data does not break down commercial mortgages to nonfinancial corporations into those held by banks versus non-banks.
[12] "Private credit" refers to non-traded commercial credit instruments that are originated and funded by non-bank institutions. Historically, private credit was used to finance mid-sized firms with revenues between $10 million and $1 billion. However, in recent years, private credit has been competing more directly with the syndicated loan market which caters to larger firms. The biggest recent providers of private debt have been private credit funds and BDCs. Private credit funds are finite-horizon, closed-end funds that primarily invest in private credit instruments. BDCs also invest in private credit, but are perpetual, closed-end funds that are financed using public equity and bond issues.

Importantly, the trends seen in Figure 2 do not show up when we look at lending to the *non-corporate* nonfinancial sector. As shown in Figure 3, this sector, which can be thought of as capturing the smaller, unincorporated businesses in the economy, continues to be highly bank-dependent. The blue line in Figure 3 displays the same construct as the blue line in Figure 2—bank loans to total non-mortgage loans—but for the unincorporated firms the bank share actually rises in the early part of the sample and has fluctuated between roughly 80% and 85% over the last twenty years. This divergence suggests that non-banks such as private credit funds and BDCs are thus far not making meaningful inroads in lending to the smallest firms. This in turn implies that they pose less of a competitive threat to the small banks, whose lending business is largely dependent on relationships with these small firms. Rather, it is the lending model of the larger regional banks that appears to be most exposed to competition from non-banks.

Returning to the corporate nonfinancial firms, the erosion in the bank share of credit to these firms—most apparent in the blue line in Figure 2—comes between 2000 and the onset of the global financial crisis in 2008. This is in part due to the rapid growth of non-bank leveraged lending during this period. Figure 4 documents the growth of the leveraged lending market by lender type over the 1996 to 2023 period. The leveraged lending market has always been dominated by non-bank financial institutions, including CLOs, mutual funds, insurance companies, and pension funds. Thus, rapidly growing leveraged lending represents an aggregate substitution away from bank-provided finance. In particular, participation in the leveraged loan market by non-bank institutional investors grew from almost nothing in 2000, to about $400 billion on the eve of the global financial crisis and stands at around $1.2 trillion today.

As noted above, Figure 2 presents an incomplete picture of non-bank competition in lending to the corporate sector, because the data underlying the figure does not include private credit funds and BDCs, which grew very rapidly in the post-GFC period. This can be seen in Figures 5 and 6. Figure 5 plots loans held by BDCs. Total lending by BDCs has grown from about $40 billion in 2013 to $230 billion today. To benchmark these magnitudes, over the same period, total bank loans to nonfinancial corporations have grown by $700 billion. So, the incremental market share captured by BDCs alone is economically quite significant.

Figure 6 plots an estimate of the deployed capital of U.S. private credit funds. Since 2013, deployed capital by private funds—a concept broadly analogous to loans on their books—has

grown by about $300 billion.[13] Thus, the combined lending to nonfinancial corporations from BDCs and private credit funds has grown by almost $500 billion since 2013. This figure is roughly in the same ballpark as the $700 billion increase in bank loans to nonfinancial corporations over the past decade. So, even excluding all other more established forms of non-bank finance to firms, such as the leveraged loan market and the corporate bond market, these two relatively new sources of non-bank credit alone are now very significant competitors in an important segment of the corporate lending market. [14]

One place where banks have not lost any appreciable ground is when it comes to providing commitment-based revolving loans to corporations. According to Shared National Credit Program data as of 2022Q2, banks hold over 97% of the $1.4 trillion of outstanding syndicated revolving loans. By contrast, banks hold only 26% of the $1.5 trillion of outstanding term loans. This implies that almost all the gains in market share that non-bank lenders have made in corporate lending have come in the market for installment credit. These findings are consistent with the view in Kashyap, Rajan and Stein (2002) that deposit-taking, and the resulting need to hold a buffer stock of high-quality liquid assets as well as the associated access to the central bank's lender of last resort function, give banks a particular comparative advantage over non-banks in supplying on-demand lines of credit.[15]

What explains these trends? At a high level there are two main forces that might explain banks' declining share of credit intermediation. First, the migration away from banks might be driven by advances in informational, contracting, and organizational technologies—e.g., the development of securitization or new underwriting techniques by non-banks. Second, the migration away from banks might be due to changes in financial regulation. Using a structural approach, Buchak, Matvos, Piskorski, and Seru (2024) find that changes in technology and the

[13] This figure is compiled using data from PitchBook. We also obtain similar magnitudes using Preqin data. See Jang (2024) for further details.

[14] An important distinction between the syndicated lending market on the one hand, and private credit funds and BDCs on the other, is that banks still play a role in originating syndicated loans, even if they do not hold large amounts of these loans on their own balance sheets. By contrast, banks play no role whatsoever with respect to loans made by private credit funds and BDCs.

[15] The idea is that banks have a balance-sheet driven—as opposed to informational—advantage at extending revolving lines of credit. Since revolving loans can be drawn down on demand by borrowers, they have a similar contingent liquidity profile to demand deposits. Thus, to the extent that loan commitment drawdowns are imperfectly correlated with deposit withdrawals, a financial institution that combines deposit-taking with commitment-based lending can economize on its costly buffer stocks of high-quality liquid assets. Empirically, loan commitment drawdowns tend to be strongly negatively correlated with deposit withdrawals in the time series, implying that banks have a significant advantage in making commitment-based loans (Gatev and Strahan (2006) and Li, Strahan, and Zhang (2020)).

deepening of securities markets account for the considerable migration of credit intermediation away from banks that was witnessed from the 1970s to the 1990s. While this migration has continued since 2000—in part due to the heightened regulation of banks since the 2008 Global Financial Crisis—they show that the rate of migration has decelerated. Reviewing the recent literature, Erel and Inozemtsev (2024) survey the evidence that heightened bank regulation has contributed to migration since 2008. At the same time, there is also strong evidence that non-bank lenders have been far more innovative and that these technological shifts have also contributed to migration since 2008 (Lerner, Seru, Short, and (2023) and Schneider, Strahan, and Yang (2023).

IV. Implications for Bank Portfolio Shares

The combination of these two broad trends—rapid deposit growth and strong competition from non-bank providers of corporate credit—has, not surprisingly, left a mark on the composition of bank balance sheets. This is shown in Table 1, which documents changes in banks' asset mix from 2000 to 2023. There are three panels in the figure. The first examines the aggregate balance sheet of the entire banking sector over time and displays the share of bank assets represented by the following categories: (i) total loans; (ii) C&I loans; (iii) C&I plus owner-occupied commercial real estate (CRE) loans; (iv) total cash and securities; (v) cash and securities with maturity of less than three years; (vi) cash and securities with maturity of greater than three years; and (vii) central bank reserves.[16] The second panel repeats the exercise, but focuses only on those smaller banks with assets of less than $100 billion in 2023 dollars in each period. The third panel focuses on the complementary set, those larger banks with assets of greater than $100 billion.

Focusing on the third panel, we see that for larger banks total loans have fallen from 61% of assets in 2000 to 49% of assets in 2023. Moreover, almost all of this 12 percentage-point decline is accounted for by the C&I category, where loans have fallen by 8 percentage points of assets, from 20% to 12%. Interestingly, however, this share has been roughly flat in the post-GFC era, despite the very strong growth of private-credit funds and BDCs, which one might have expected

[16] An owner-occupied commercial mortgage is essentially a C&I loan to firm where the bank has taken a lien on some of the firm's real estate assets (e.g., offices, manufacturing plants, or warehouses). We create an additional category for C&I plus commercial mortgages secured by owner-occupied nonresidential properties on the premise that this might be a better proxy for total lending to nonfinancial business, which in turn we take to be the leading example of traditional information-intensive bank credit provision. However, as the figure shows, owner-occupied CRE lending is relatively small in magnitude, so the story told by C&I plus owner-occupied CRE is essentially the same as that told by just C&I lending taken alone.

would have driven the bank portfolio share in C&I lending even lower. We suspect that the resolution to this apparent paradox is that overall loan demand, and hence aggregate lending volume, was very strong during this period of generally low interest rates and easy credit conditions. Mechanically, even if banks are losing a considerable share of the market for corporate loans, but at the same time the total size of the market is growing briskly, banks' volume of corporate lending may be holding up better than it otherwise would. Of course, a corollary of this reasoning is that if the growth of aggregate loan demand slows in the current higher interest-rate environment, and the non-bank providers of credit retain their higher market shares, banks' portfolio shares in C&I lending may decline even further.

The flip side of a reduced share of loans on bank balance sheets is an increased share of cash and securities. For the larger banks in the third panel of the figure, we see that cash and securities have gone from 24% of assets in 2000 to 39% of assets in 2023, representing a quite dramatic re-configuration of their balance sheets. Furthermore—and this observation will be crucial when we turn to policy implications—even as total securities holdings have gone up, and even as these securities holdings are now increasingly funded with uninsured, rather than insured deposits, the share of securities with maturities of greater than three years has actually increased somewhat, from 12% in 2005 to 16% today. This is important because, as the Silicon Valley Bank episode has taught us, an especially combustible mix is the combination of (i) interest-rate risk coming from long-maturity securities holdings; and (ii) a large proportion of runnable uninsured deposits (Drechsler, Savov, Schnabl, and Wang (2023)). Even if one believes that sticky and effectively long-duration insured deposits are a sensible way to fund long-duration securities, the same cannot be said for more run-prone uninsured deposits.

What are the long-duration securities that have become increasingly important on larger-bank balance sheets? Mortgage-backed securities (MBS) play a leading role. And indeed, the growth of their MBS holdings has helped turn banks into the by-far-leading private players in the mortgage market. This is illustrated in Figure 7, which plots banks' share of the 1-4 family residential mortgage market, where the total size of the market is defined excluding the Federal Reserve's holdings via its QE programs. There are two lines in the figure. The lower blue line captures banks' share of the whole-loan mortgage market. As can be seen, banks are less prominent in terms of holding whole loans, with a market share that has fluctuated between roughly 30% and 35% over the last few decades, but that shows no discernible trend.

The story looks very different when we examine the upper red line, which presents banks' share of the combined whole-loan and agency-MBS mortgage markets. Here the bank share soars from about 40% in 2008 to over 70% in 2021, before retracing somewhat to around 60% in 2023. In other words, their growth in MBS holdings is entirely responsible for banks' much-increased presence in the overall mortgage market in recent years.

A first reaction to Figure 7 might be that the rise in banks' share of the MBS market since 2008 is a mechanical reflection of the Fed's large purchases of MBS. This is not quite right. It is true that the Fed has taken a lot of MBS out of private hands, so that the bank share of the private market would mechanically grow even if bank holdings were not increasing in absolute dollar terms. But this fact still leaves the question why it is other non-bank private holders of MBS, such as bond mutual funds, that have been most willing to cede their MBS to the Fed. Said differently, bank demand for MBS has increased very strongly *relative* to MBS demand from other private investors over the last 15 or so years. And these other investors are quite capable of intermediating agency MBS. Apparently, the combination of banks' eroding position in the corporate credit market and their large deposit inflows has given them a powerful appetite for MBS.[17]

Going back to Table 1, it is instructive to compare the trends in balance-sheet composition for the larger banks in the third panel of the table to those for the smaller (less than $100 billion in assets) banks in the second panel. In sharp contrast to the larger banks, the smaller banks have not seen any noticeable decline in the share of either total loans or C&I loans on their balance sheets. For example, total loans are 62% of small-bank assets in 2000, and 65% of small-bank assets in 2023. Correspondingly, cash and securities are also roughly stable for small banks over the same period, going from 32% of assets to 28% of assets. This fits closely with the conclusion that we drew from the comparison of lending to nonfinancial corporate firms versus nonfinancial non-corporate firms in Figures 2 and 3. Given that non-bank lenders have not gained significant market share in lending to the smallest firms in the economy, their growth has not made a discernible

[17] Banks are overweight MBS relative to a passive U.S. government bond fund that owns Treasuries and agency-backed MBS in proportion to their outstanding market values. Specifically, Treasury and agency securities currently make up roughly 78% of banks' securities portfolio. Within this government securities bucket, banks currently hold 70% of their assets in agency MBS and the rest in Treasuries. By contrast, a value-weighted government bond fund would hold roughly 32% of its assets in agency MBS. Although we cannot offer definitive proof, we suspect that banks' preference for MBS reflects the facts that MBS receive nearly as favorable regulatory treatment but offer higher yields than Treasuries. The analogy is not exact, but agency MBS are similar to callable Treasury bonds and thus offer a meaningful yield spread over Treasuries because MBS holders are short a valuable call option. However, since banks are typically concerned with the reported interest income on their securities—i.e., banks care about yield and not simply total returns, they may perceive MBS as being more attractive than Treasuries as in Hanson and Stein (2015).

impact on the balance sheets of small banks. Instead, it is the larger regional banks whose business has been most disrupted by the increasing importance of non-bank credit providers.

V. Cross-Sectional Evidence

A simple way to summarize our interpretation of the aggregate time-series trends above is to say that, for the banking sector as a whole, deposit growth has outstripped growth in traditional lending opportunities in recent years seen. This contrasts with a situation where lending opportunities are growing rapidly, and banks must bid aggressively to raise additional deposits to finance an expansion of their lending portfolios. To further bolster our preferred interpretation, it is helpful to look in more detail at the cross section of banks. In Table 2, we run the following cross-sectional regression over the 2010–2023 period:

$$\left(\frac{Y}{A}\right)_{i,2023} - \left(\frac{Y}{A}\right)_{i,2010} = \alpha + \beta \cdot \ln\left(\frac{Deposits_{i,2023}}{Deposits_{i,2010}}\right) + \varepsilon_i.$$

where A is total bank assets, and Y refers to a variety of specific asset categories (e.g., total loans, C& loans, cash, and securities, etc.). Thus, we are asking how deposit growth over the 2010 to 2023 period has been associated with changes in asset composition in the cross-section of banks.[18] Panel A of Table 2 displays the results for the set of banks with assets over $1 billion in current dollars, and Panel B focuses on the smaller set of large banks (23 observations) that currently have over $100 billion in assets.

Looking first at Panel B, we see that among the larger banks, more rapid deposit growth is associated with a decline in the share of total loans to assets, the share of C&I loans to assets, and the share of C&I plus CRE loans to assets. Correspondingly, more rapid deposit growth is associated with a sizeable increase in the share of cash and securities to assets. In terms of economic magnitudes, the point estimates imply that a one-standard deviation increase in deposit growth is associated with a 4.1 percentage point decline in the ratio of loans to assets, offset by a 3.3 percentage points rise in the ratio of cash and securities to assets. Given the small sample size, we are hesitant to read too much into these coefficient estimates. Nevertheless, they fit qualitatively with the inference we have drawn from the time series: namely that, especially among the larger

[18] These regressions are purely descriptive in nature. Thus the regression coefficients should not be interpreted as estimates of the causal effect of deposit growth on the composition of bank balance assets.

regional banks, deposit growth has led to a reduced share of loans on the balance sheet, and an increased share of cash and securities.

Panel A covers all banks, and importantly, weighs them all equally, so that the results are driven primarily by the smaller banks. Here, the patterns are directionally reversed, and the statistical significance is spotty. Now a one-standard deviation increase in deposit growth between 2010 and 2023 is associated with a rise in the ratio of loans to assets of 2.3 percentage points, and a decline in the ratio of cash and securities to assets of 1.1 percentage points.

We next turn to the role of uninsured deposits more specifically. It could be the case that uninsured deposits are particularly important for funding lending on the margin—perhaps because banks turn to the uninsured wholesale deposit market when their lending opportunities are too expansive to be funded by their retail deposit bases. This turns out to not be the case.

To see why, Table 3 examines the cross-sectional relationship between balance sheet shares and the composition of deposits. Specifically, for a single cross-section in 2023Q2, and for the sample of the 814 banks with assets over $1 billion, we regress bank asset shares on uninsured deposits as a share of assets, controlling for total deposits as a share of assets. In other words, we are asking how asset composition changes as insured deposits are swapped for uninsured deposits, holding fixed total deposits.

The first column of Table 3 shows that while the loans-to-assets ratio is positively correlated with the ratio of total deposits to assets, it is negatively correlated with the ratio of uninsured deposits to assets. A one-standard deviation increase in the uninsured deposits-to-assets ratio is associated with a 1.8 percentage point decline in the loans-to-assets ratio. The remaining columns of the table show that this decline in loans is mirrored by a rise in cash and securities, with this increase roughly equally divided between reserves, cash and securities with maturities of 3 years or less excluding reserves, and securities with maturities greater than 3 years.

These results are again broadly consistent with the aggregate time trends documented above. In the aggregate, uninsured deposits have grown rapidly even as loans have declined as a fraction of assets. Similarly, in the cross section, high uninsured deposits are associated with less lending, not more. To some extent, this could reflect privately optimal liquidity management in a world with deposit-led growth and modest lending opportunities. Banks flush with more uninsured deposits might be mindful that these deposits are potentially flighty, and therefore hold larger liquidity buffers. However, it is worth noting that these liquidity buffers are held largely in the

form of longer-maturity securities, and indeed, as uninsured deposits go up the cross-section, so too does the share of longer-maturity securities on the balance sheet. As argued by Drechsler, Savov, Schnabl, and Wang (2023), if uninsured deposits are vulnerable to run risk, this run risk may actually be exacerbated to the extent that these deposits are funding long-duration securities.

Finally, in Table 4 we examine the importance of their deposit and lending franchises for bank equity valuations using a simplified version of the empirical strategy from Egan, Lewellen, and Sunderam (2022). The goal is to assess the degree to which each activity contributes to the private value of banks as seen by their shareholders. This private value is only a subset of the total social value that banks create, but it is directly measurable from equity market valuations. Table 4 considers a sample period from 2010 to 2023 and estimates panel regressions of the form:

$$\left(\frac{M}{B}\right)_{it} = \alpha_t + \beta_D \cdot r_{it}^{Deposit} + \beta_L \cdot r_{it}^{Loan} + \gamma_D \cdot \ln(Deposits_{it}) + \gamma_L \cdot \ln(Loans_{it}) + \boldsymbol{\delta}'\mathbf{x}_{it} + \varepsilon_{it}.$$

where $(M/B)_{it}$ is the market-to-book ratio of bank *i* in year *t*, $r_{it}^{Deposit}$ is the average net-of-fee rate that bank *i* pays its depositors and r_{it}^{Loan} the average rate that it earns on its loans. The regression asks how much a decrease in deposit rates or an increase in loan rates raises bank equity valuations, holding fixed the scale of deposit taking and lending. We include year fixed effects so that the coefficients are identified from cross-sectional variation across banks in a given year rather than variation over time.

Column 1 of Table 4 examines all publicly listed banks with assets over $1 billion in current dollars. The coefficient on deposit rates, β_D, is negative and significant, indicating that, as expected, banks that pay their depositors lower interest rates have higher equity valuations. The coefficient on loan rates, β_L, is positive: banks that earn higher rates on their loans also have higher valuations. However, the coefficient is close to zero in magnitude and is insignificant, suggesting that for all banks, the deposit franchise contributes far more to stock-market value than the lending franchise.[19] Column 2 shows that we obtain similar results if we restrict attention to the subset of banks with assets of less than $100 billion.

The difference between the value created by deposits and the value created by the lending business can be better understood by decomposing the market-to-book ratio into the price-to-earnings ratio and the earnings-to-book ratio (return on equity). In un-tabulated results, we find

[19] Using a more sophisticated empirical approach, Egan, Lewellen, and Sunderam (2022) reach a similar conclusion.

that lower deposit rates and higher loan rates both increase the earnings-to-book ratio—i.e., both increase bank profits. However, lower deposit rates do not affect the price-to-earnings ratio, while higher loan rates are correlated with lower price-to-earnings ratios. In other words, stock-market investors treat banks with higher loan rates as riskier, and hence penalize their valuations accordingly. But they do not treat banks with lower deposit rates in the same way.

To summarize our empirical findings: over the last twenty-plus years, banks have seen rapid growth in their deposits, with much of this growth coming from uninsured deposits. At the same time, larger banks—those broadly categorized as regional banks—have faced increasing competition on the lending side from a variety of non-bank players, including most recently the fast-growing private-credit and BDC sectors. As a result of these two forces, the asset portfolios of the regional banks have shifted significantly away from lending, and towards holdings of long-term securities, specifically long-term Treasury bonds and MBS. These time-series patterns also have analogs in the cross-section, where we find that those banks with the fastest growth of deposits in recent years have seen the biggest declines in lending as a share of assets, and the biggest increases in cash and securities as a share of assets.

In what follows, we ask how these observations about the evolution of the banking system should shape one's views towards bank regulation in general, and particularly towards liquidity regulation—i.e., regulatory efforts to mitigate the run risks posed by much-increased levels of uninsured deposits in the system.

VI. Policy Implications

We now turn to policy implications. We discuss three topics: (i) the design of deposit insurance and liquidity regulation—specifically, how to best deal with the run risk created by large amounts of uninsured deposits in the banking system; (ii) how capital regulation might be adjusted to deal with interest-rate risk on banks' securities holdings; and (iii) merger and competition policy. The first of these, deposit insurance and liquidity regulation, involves some subtle tradeoffs, and we sketch a simple model to help clarify the issues.

A. Deposit Insurance and Liquidity Regulation

As noted above, 39% of all domestic deposits currently held in U.S. banks are uninsured, an increase of 19 percentage points from 1995. And for banks with more than $100 billion in assets,

27% of banks have uninsured deposits greater than 50% of their total domestic deposits. The bank failures of early 2023 highlighted the run risks associated with large amounts of uninsured deposits, and it now seems clear that technology and social media have, in certain circumstances, made these uninsured deposits more vulnerable to extraordinarily rapid and intense runs (Benmelech, Yang, and Zator (2023); Cookson, Fox, Gil-Bazo, Imbet, and Schiller (2023); Koont, Santos, and Zingales (2023)).

The question we take up in this section is how best to address the run risk associated with this large volume of uninsured deposits. Our basic premise is that increased equity capital requirements alone, while helpful, are not sufficient for this task. There also needs to be a distinct and robust liquidity-oriented regime to complement capital regulation.

One obvious way to reduce the run risk associated with this high current level of uninsured deposits would be simply to expand the scope of deposit insurance coverage. As recently detailed by the FDIC, there are various options under this umbrella, from raising the deposit insurance limit somewhat from its current value of $250,000, to fully insuring business payment accounts, all the way to fully insuring all domestic deposits.[20] Proponents of more aggressive versions of this approach sometimes argue that because uninsured depositors rarely are subject to losses in bank failures, these deposits are already *de facto* insured. So, the argument goes, one might as well make this insurance explicit, and thereby eliminate run risk. Further, extending insurance to all deposits would entail banks paying higher deposit insurance premia, thereby forcing at least partial internalization by banks of the associated costs.

As a practical matter, it seems highly unlikely that Congress would be willing to significantly expand deposit insurance coverage, at least in the foreseeable future. Thus, a response to run risks will almost surely need to be fashioned under existing authority of the federal banking agencies. Political constraints aside, though, there are potentially important costs associated with a significant expansion of deposit insurance. Because deposit insurance can never be perfectly risk-sensitive, expanding coverage will arguably create some additional amount of moral hazard.[21]

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[20] Federal Deposit Insurance Corporation, Options for Deposit Insurance Reform, May 1, 2023, available at https://www.fdic.gov/analysis/options-deposit-insurance-reforms/report/options-deposit-insurance-reform-full.pdf.

[21] Of course, the FDIC should strive to minimize the extent of moral hazard by making the insurance regime appropriately risk sensitive. However, since asset risk is not observable and since banks will arguably always know more about the risk of their assets than the FDIC, deposit insurance entails moral hazard costs. Thus, policymakers need to solve the second-best problem that involves trading off the run-stopping benefits of deposit insurance against its moral hazard costs in terms of distorting banks' decisions relative to the first best.

These moral hazard costs could arise because deposit insurance distorts banks' *ex ante* risk-taking decisions in normal times—e.g., by encouraging banks to invest in excessively risky assets—or banks' *ex medio* decisions after they have suffered large losses—e.g., by allowing zombie banks to either lumber on or, even worse, to gamble for resurrection.[22] In its May 2023 review of options for deposit insurance reform, the FDIC also evinced concern about the impact of such a major change in policy on the adequacy of the deposit insurance fund and the dynamics of wholesale funding markets.[23]

An alternative approach to reducing run risk is to strengthen liquidity regulation by, for example, modifying the Liquidity Coverage Ratio (LCR) to require uninsured deposits to be largely backed with Treasury bills and other short-term Treasuries. The LCR, which currently only applies to very large banks, requires that banks maintain sufficient "High Quality Liquid Assets" (HQLA) to cover their anticipated net cash outflows over a 30-day period of stress. [24]

How one feels about this approach will naturally be colored by how one interprets the evidence we have presented above. At one extreme, if one believes that, at the margin, the banking system is raising uninsured deposits and largely investing them in long-term securities such as MBS, such an approach would seem relatively attractive. Having banks make investments in long-term securities is arguably a zero-NPV activity from a social perspective, since the intermediation of long-term securities can be efficiently carried out by bond mutual funds, without creating the severe run risks associated with uninsured deposit funding.[25] At the other extreme, if one has more of a Diamond-Dybvig (1983) view and believes that, even at the margin, wholesale bank deposits

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[22] Even banks that are deeply insolvent often manage to stay above their regulatory capital minimums—and hence avoid intervention from forbearance-inclined regulators—given the backward-looking nature of accounting-based measure of equity capital. Although it would be a stretch to argue that uninsured depositors exert discipline on banks in the normal course of business, in many cases the event that forces an economically unviable bank to be shut down is something that looks like a run by uninsured depositors. The S&L crisis of the 1980s and early 1990s is a useful lesson in this regard, as many highly deposit-insured S&Ls kept operating for many years in a zombie state, gambling for resurrection while increasing their losses and the ultimate costs to taxpayers.

[23] FDIC Options Paper at pp. 44-46.

[24] The LCR specifies the eligible HQLA and, as discussed below, projects the anticipated net cash outflows during the 30-day stress period based on an assumed run-off rate for each type of liability on the bank's balance sheet. At present, only banks with assets greater than $700 billion (or short-term funding greater than $75 billion) are subject to the full LCR which requires them to hold enough HQLA to cover 100% of 30-day stressed outflows. Depending on their levels of "weighted short-term wholesale funding," banks with assets between $100 and $700 billion are subject to either a reduced LCR requirement (e.g., they must hold enough HQLA to cover between 70% and 85% of stressed outflows) or no LCR requirement at all (for banks with assets between $100 and $250 billion that have less than $50 billion in weighted short-term wholesale funding).

[25] Some have argued that, as in money market funds, investors in bond funds may enjoy a first-mover advantage in redeeming their shares during periods of stress. However, even those who agree with this view have not suggested the run risk is anything like that affecting a bank which promises redemption at par on a first-come first-served basis.

remain a uniquely efficient way to fund information-intensive credit provision, one is naturally going to be more sympathetic to expanding insurance coverage, rather than leaning against the growth of wholesale deposits.

To clarify these issues, and to help formulate a more specific proposal, we develop a simple model of a representative bank that initially funds itself in significant part with uninsured deposits and can invest in three assets: information-intensive loans (i.e., assets that are risky and illiquid), longer-term securities (i.e., assets that are risky but liquid), and short-term T-bills (i.e., assets that are both safe and liquid). The first goal of the model is to weigh the merits of expanded deposit insurance versus a modified LCR in dealing with deposits that are currently uninsured. An obvious proposition is that we should tilt in the direction of a modified LCR if expanding deposit insurance creates significant additional moral hazard or fiscal costs. Or, in the language of interior solutions, the model at minimum implies that one does not want to solve the entire problem with an expansion of deposit insurance.

A somewhat more subtle proposition—one in the spirit of our empirics—is that an LCR rule is more costly when banks have a lot of positive-NPV lending opportunities, since forcing them to hold liquid assets to comply with the LCR will crowd out more valuable lending.[26] If, as the data suggests, banks now have more uninsured deposits relative to their lending opportunities, an LCR rule looks more attractive compared to expanded deposit insurance.

Another goal of the model is to inform the design of the modified LCR. The model speaks to some of the key questions in adapting the LCR, including whether all uninsured deposits should be fully backed, what assets should qualify as backing for those deposits, and how liquidity regulation should interact with Discount Window lending.

To the extent that bank lending creates social value that is not equally available outside the banking system, the model suggests that the liquidity coverage requirement on uninsured deposits should be calibrated carefully so as to not overly constrict bank lending. At the same time, the model is quite clear in saying that it is problematic to back uninsured deposits with long-duration securities rather than T-bills and other short-term Treasuries. This is because we assume that long-duration securities can equally well be intermediated outside the banking system, with less run risk

[26] Implicit in this statement is that crowding out is more of a problem when bank equity is costly. If there are no costs to bank equity, all problems can be solved by having banks issue enough equity to both invest in loans at the first-best level and hold enough liquid assets to obviate any run risks.

by, e.g., bond mutual funds. We use these implications, along with some considerations not addressed in the model, to put forward a framework for developing a more robust LCR.

Model Assumptions

The version of the model that we sketch here is deliberately kept very simple, with several shortcut assumptions made to minimize the required algebra and keep the focus on the policy implications. We consider a representative bank—one of many identical banks—that operates at fixed scale and with a fixed capital structure: it has equity of E, small, insured retail deposits from households of D_R, and large wholesale deposits from firms of D_W. By fixing the capital structure in this way, we are implicitly assuming a frictional social cost of using additional equity financing. Otherwise, the problems that we address here could be solved at zero social cost simply by making the bank finance itself with a large quantity of equity. In that case, it could always both lend at the first-best level while still hold enough liquid assets to buffer any amount of deposit outflows. So, while it is implicit, the constraint on equity is playing an important role.[27]

On the asset side, the bank can (i) make loans of L; (ii) hold longer-term risky securities in amount S, and (iii) hold short-term, very low-risk securities—which we refer to as "T-bills" for simplicity—in amount B. So, the bank's initial balance sheet constraint is that $L + S + B = D_R + D_W + E$. There are three dates: at time 0, the bank chooses its asset mix. At time 1, there is an interim signal about the payoffs on the loans and the securities. With probability p, there is a bad signal. For loans, the bad signal implies that (i) the expected time-2 payoff on the loans has declined to $F_L L < L$, and (ii) there is now a non-zero probability of an extremely bad crisis state in which the loans will only pay off some very small amount $0 \leq z_L L < F_L L$. We will begin by considering the limiting case where $z_L = 0$, but will later ask how things change when $z_L > 0$.

[27] Why is bank equity costly? There are many reasons why it is *privately* costly for banks to rely on equity financing. However, many of these private costs do not qualify as social costs: while they affect the division of the economic pie between bank equity holders and other agents, they do not impact the total size of the pie (Admati, DeMarzo, Hellwig, and Pfleiderer (2013)). For example, the tax disadvantages of equity are a private, but not a social cost. Of course, since deposit-taking is socially valuable, equity capital requirements that limit banks' ability to accommodate the demand for deposits may be socially costly. However, this does not explain why it would be socially costly for banks to issue large amounts of equity to expand their holdings of high-quality liquid assets. In that case, banks could *both* lend *and* take deposits at the first-best level while holding enough liquid assets to meet deposit outflows. In this regard, one possible social cost of equity might arise from the agency problem between bank managers and outside investors, with the idea being that debt—particularly short-term debt—helps discipline managers, thereby increasing the size of the pie (Diamond and Rajan (2001)). However, even if one believes that the direct social costs of bank equity are small, a substantial increase in bank equity capital requirements might still be costly for society. This is because, in attempting to economize on the private costs of equity, lending activity could flow out of banks and into other more lightly-regulated areas, thereby posing threats to financial stability (Hanson, Kashyap, and Stein (2011)).

Similarly, for securities, the bad signal implies that the expected payoff has declined to $F_S S < S$, perhaps because interest rates have risen in the bad state. The key distinction between loans and securities is that while both can lose value at time 1, the securities are nonetheless perfectly liquid, in that they can be sold for their full expected value at time 1. By contrast, as we explain in more detail shortly, the loans are illiquid at time 1, and selling them involves accepting a fire-sale discount relative to fundamental value. At time 2, all payoffs are realized.

We assume that there is a first-best level of loans L^{FB}. Any amount of lending L up to this level creates social surplus of πL where $\pi > 0$ is a constant; beyond this point, lending creates no incremental social value. We further assume that $L^{FB} < D_R + D_W + E$, so that even if the bank is doing the first-best level of lending, it will hold some T-bills or securities. Thus, we are focusing on deposit-rich banks—i.e., banks whose ability to lend is not constrained by the availability of deposits. This is consistent with the findings from our empirical work. At the same time, we assume that $L^{FB} > D_R + E$. This creates a meaningful tension, since if we require that wholesale deposits be fully backed with liquid T-bills or securities, this will push lending below the first-best level.

Three simple policy options

By assumption, the retail deposits of D_R are always insured. We then begin our analysis by contrasting three simple policy options for dealing with the wholesale deposits. To be clear, these three options are effectively polar extremes and are intended to highlight the tradeoffs at play in the starkest way.

Option 1: Full expansion of deposit insurance. In this case, the large wholesale deposits of D_W are fully insured. As a result, there are no runs at time 1, and no liquidity-based reason for the bank to forgo lending in order to hold an excess buffer stock of liquid assets. So lending is at the first-best level of L^{FB}, and the only social cost is that the increased deposit insurance leads to some additional moral hazard or fiscal cost, which imposes a social cost of $X > 0$. One interpretation of this cost, which in the spirit of Diamond and Rajan (2001), is that because there is no run in the bad state at time 1, insolvent banks do not get shut down by regulators and become over-leveraged zombies who make bad lending decisions. So, the cost is only realized at time 1 in the bad state of the world and represents a form of excessive forbearance. Alternatively, a bank that is fully insured may make bad ex ante decisions, i.e., take on negative-NPV risky bets at time 0.

Option 2: No expansion of deposit insurance, no liquidity regulation. In this case, the large wholesale deposits remain uninsured and the bank freely chooses its asset mix without any constraints from regulation. Suppose it picks quantities L^*, S^*, and B^* for loans, securities, and bills, respectively. Here one potential cost is that, because of the risk of insolvency, the uninsured depositors necessarily run at time 1 upon observing the bad signal; this is their only way of assuring that they will be paid in whole. And these depositors may have to be accommodated in part by fire-selling illiquid loans, to the extent that the market value of the liquid securities and bills is not enough to cover all the uninsured deposit outflows. Although the loans of L^* have an expected value of $F_L L^*$, if they are fire-sold at time 1 they fetch only $k_L F_L L^* < F_L L^*$, where $k_L < 1$ is the fire-sale discount. To pay off all the wholesale depositors at time 1, the bank therefore has to sell a fraction Δ_L of its loans such that $\Delta_L k_L F_L L^* + F_S S^* + B^* = D_W$. The private cost to the bank of this policy is the expected value of fire-sale losses on its loans, which is given by $p\Delta_L(1-k_L)F_L L^* = p(1/k_L - 1)(D_W - B^* - F_S S^*)$. Because the bank internalizes these fire-sale losses, it will seek to mitigate them by holding liquid assets and doing less lending. Thus, even without an LCR, the bank will choose to set $L^* < L^{FB}$. That is, the bank will self-impose some form of liquidity buffer policy.

To see what this self-imposed liquidity buffer looks like, suppose for the moment that the bank sets $S^* = 0$—i.e., that the buffer is held entirely in T-bills as opposed to longer-term securities, so the bank's balance-sheet constraint implies $(L - D_R - E) = (D_W - B)$. At an interior optimum, where the bank is indifferent between loans and bills, the marginal value of an additional loan must equal the fire-sale-preventing benefit of an additional bill, which implies that $\pi = p(1/k_L - 1)$. We assume that $1/k_L$ is determined in equilibrium by the fire sales of all banks and is increasing in the quantity of fire sales $D_W - B$. Letting $h[D_W - B]$ denote the private costs of fire-sales where $h'[D_W - B] = p(1/k_L - 1) > 0$ and $h''[D_W - B] > 0$, the outcome in the unregulated case where the bank chooses the buffer satisfies $\pi = p(1/k_L^* - 1) = h'[D_W - B^*] = h'[L^* - D_R - E]$ where $k_L^* < 1$ is the equilibrium fire-sale discount and $L^* < L^{FB}$.

The need for a stricter regulatory LCR rule arises to the extent that fire sales of loans create social costs that are not internalized by individual banks. To capture these in a simple way, assume that when the bank liquidates $(D_W - B)$ loans to cover uninsured deposit withdrawals, the expected private costs are $h[D_W - B]$, but the expected social costs are $(1+\phi)h[D_W - B]$ where $\phi > 0$. In other words, we assume that these fire-sale liquidations impose some financial stability

costs that the bank does not fully internalize (e.g., a negative effect on the balance sheets and market liquidity of other firms holding the affected assets or an uninternalized effect on future investment). This creates a motive for a regulator to require the bank to hold more T-bills and engage in less lending than the bank would choose if left to its own device. Specifically, the planner wants the bank to make loans L^{**} where $\pi = (1+\phi)p(1/k_L^{**} - 1) = (1+\phi)h'[L^{**} - D_R - E]$, implying that $D_R + E < L^{**} < L^*$.

Thus, the total social cost of the unregulated market outcome is given by $\pi(L^{FB} - L^*) + (1+\phi)h[L^* - D_R - E]$ and consists of both the cost in terms of foregone lending and the social fire-sale cost. By definition, this is greater than the social cost that the planner could achieve using optimal LCR regulation which is $\pi(L^{FB} - L^{**}) + (1+\phi)h[L^{**} - D_R - E]$.

Option 3: No expansion of deposit insurance, strict liquidity regulation. A simple limit case—though not the global regulatory optimum—is a strict LCR policy that requires that the bank back all its uninsured wholesale deposits with T-bills, so that $B^{Strict} = D_W$ and therefore $L^{Strict} = D_R + E < L^{**} < L^{FB}$. Now there is no moral hazard from expanding deposit insurance and there are no fire-sale costs (i.e., $h[0] = 0$). The only cost is that with less lending and more bills as assets, the bank foregoes more loans at cost $\pi(L^{FB} - L^{Strict})$.

The basic proposition that follows from this is that if this foregone-lending cost is smaller than both the moral-hazard cost X and the social costs of the unregulated outcome, then a policy of no deposit insurance for wholesale deposits and a strict T-bill-backed LCR is preferred relative to either the unregulated market outcome or an expansion in deposit insurance. Arguably, our empirical evidence suggests that the costs of foregone lending may be relatively small for most larger banks, specifically that $\pi(L^{FB} - L^{Strict})$ is small.

Of course, the optimally calibrated LCR which involves lending of $L^{**} > L^{Strict}$ and holding a liquidity buffer of $B^{**} < D_W = B^{Strict}$ T-bills is always superior to both the unregulated market outcome and the strict LCR. This optimally calibrated LCR will also be superior to a full expansion of deposit insurance if $\pi(L^{FB} - L^{**}) + (1+\phi)h[L^{**} - D_R - E] < X$.

More generally, one can imagine using various combinations of (i) more stringent LCR regulation, (ii), heightened equity capital requirements, and (iii) a partial expansion of deposit insurance to deal with the heightened financial stability risks posed by runs by uninsured wholesale deposits. Indeed, in a richer model, it would arguably make sense to adjust regulatory policy

somewhat along all three dimensions—i.e., heightened equity capital requirements and a partial expansion of deposit insurance would complement more stringent LCR regulation. Thus, ignoring the political constraints mentioned above, we could envision pairing a more stringent LCR requirement with a modest increase in risk-based equity capital requirements and a targeted expansion of deposit insurance—e.g., raising the insurance limit for business payment accounts, one option recently outlined by the FDIC.

LCR design considerations

Taken at face value, our simple model suggests that a strict LCR requiring full backing of uninsured deposits with bills and other short-term Treasuries is preferable to no LCR at all. This would be a dramatic change in the LCR—tantamount to both increasing the runoff rate for uninsured deposits from the current maximum of 40% to 100% and disallowing all assets that are currently eligible High Quality Liquid Assets (HQLA) except short-term Treasuries and central-bank reserves. But even within the scope of the model itself, the optimal policy is something less strict. Moreover, in its simplicity, the model does not speak to all elements of an appropriate regulatory framework. In this section, we propose some considerations relevant to calibrating the strictness of a modified LCR and to specifying the assets that count as HQLA. We then make some qualifications to the simple liquidity assumptions in the model and discuss the relationship of the LCR to the Discount Window.

At the outset, we note the importance of applying the full LCR to a broader range of banks. As the events in the spring of 2023 demonstrated, there may be contagion from runs even at a mid-sized regional bank that can endanger a significant part of the banking system. Our inclination would be to require full LCR compliance by all banks with more than $100 billion in assets, the current statutory threshold for additional prudential regulation by the banking agencies.[28]

Calibrating a Modified LCR. It now seems clear that the current maximum runoff rate of 40% for uninsured deposits is woefully inadequate. It also seems quite unlikely that it would be socially optimal to require all uninsured deposits to be 100% backed by short-term Treasuries. How should the bank regulatory agencies decide where to set stringency of the LCR these two

[28] Alternatively, the agencies could require that banks in the $100 to $250 billion dollar range comply fully with the uninsured deposit requirements of the LCR, with somewhat modified requirements for other sources of stressed outflows.

boundaries? Starting from the model's implied 100% runoff rate, relaxing the strict LCR regulation envisioned in Option 3 may be warranted because (i) not all uninsured deposits are as highly runnable as is assumed in our simple model (even in light of the experience of March 2023), (ii) the costs of restricting socially valuable lending would exceed the financial stability benefits of fully backing uninsured deposits with T-bills, or some combination of the two.

The first justification for relaxation is not reflected in our simple model, which assumes all uninsured deposits to have identical characteristics. Were regulators to be convinced that some forms of uninsured deposits—such as those used by businesses to meet payrolls and make routine payments to suppliers—were genuinely less prone to run, then the amount of uninsured deposits to be backed could be reduced.[29]

As discussed earlier, a second justification for relaxing the strict LCR rule—i.e., using the optimally-calibrated LCR which involves holding T-bills equal to $B^{**} < B^{Strict} = D_W$—arises due to the marginal social costs $\pi > 0$ of reducing lending below the first-best level of L^{FB}. It is admittedly not clear how to translate this concept from the model into a simple metric that can guide the implementation of regulation. However, one factor that should probably be considered is the elasticity of substitution for the loans in question. For example, if a bank cuts back on making on-balance-sheet conforming mortgage loans, the marginal social costs π are unlikely to be very high, as these loans can easily find their way into an MBS pool. By contrast, if the marginal loans are to opaque small businesses, finding an alternative provider of credit may involve more friction, and hence greater marginal social cost π.

Finally, a third possible rationale for relaxing the strict LCR rule is the concern is that an overly strict LCR could have unintended consequences to the extent that it leads to increased money creation activity in the so-called shadow banking system. Concretely, if a strict LCR makes banks more reluctant to take uninsured deposits, investors seeking safe, short-term alternatives may park their cash in money market funds (MMFs). Flush with cash from savers and facing a shortage of short-term Treasuries (more of which would be owned by LCR-constrained banks), MMFs might conceivably increase their lending against long-term Treasuries and MBS on a short-term collateralized basis through the repo market. The expanded supply of repo financing might

[29] Coming at the issue from the perspective of deposit insurance policy, the FDIC offered an option for a limited extension of insurance that would cover that kind of deposits by firms. Federal Deposit Insurance Corporation, Options for Deposit Insurance Reform, May 1, 2023, at pp. 46-49.

in turn raise the incentive of hedge funds and other levered non-bank institutions to finance their long-term securities by borrowing short-term. [30]

While all three of these concerns are legitimate, they essentially suggest that a more stringent LCR must be appropriately calibrated to maximize the net benefits, not that the policy direction itself is ill-advised.

Two other points relevant to calibration are worth noting. First, even as one assesses reasons for relaxing the strict LCR rule implied in Option 3, there may be other considerations favoring a relatively more stringent requirement. For example, the more severe the fire-sale externalities ϕ, the more stringent should be the LCR. In other words, an increase in ϕ pushes the T-bill holdings B^{**} in the optimally calibrated LCR up towards $B^{Strict} = D_W$. Second, as regulators balance the considerations identified here, they might formulate a more nuanced rule—e.g., one alternative would be to progressively increase the assumed outflow rate on a bank's uninsured deposits as its uninsured deposits rise as a share of its total deposits.[31]

Eligible HQLA. A second important consideration in designing a revised LCR is the definition of HQLA—both the specification of assets that qualify and any limitations or conditions in counting them against runnable liabilities. The same calibrated run rate for uninsured deposits will have quite different impacts upon banks depending on the range of assets that qualify as HQLA. Accordingly, another way to effectively relax the strict LCR contemplated in Option 3 is by allowing the bank to meet some or all of its requirement to back uninsured deposits with all assets that qualify as HQLA under the current LCR, rather than just short-term Treasuries.[32] The most important consideration here is whether there should be any change in the eligibility of long-term securities such as 10-year Treasuries and agency-backed MBS. As we have seen, within their holdings of liquid assets, banks demonstrate a very strong preference for longer-duration securities.

[30]This concern may be somewhat mitigated if, as in our example, the increased repo financing is done only against government-backed collateral such as Treasuries and agency MBS. In this case, the potential damage associated with disorderly fire-sale liquidations would seemingly be relatively modest.

[31] Thus, for example, uninsured deposits constituting less than 25% of a bank's total deposits would have a run rate of 50%, those accounting for between 25% and 50% would have a run rate of 60%, those between 50% and 75% would have a run rate of 80%, and those above 75% would have a run rate of 100%.

[32] The LCR also includes reserves, all Treasuries and other liquid obligations fully backed by the United States Government, certain obligations of foreign sovereigns and international financial institutions (e.g., the World Bank), mortgage-backed securities, and certain liquid corporate securities and investment grade municipal securities. As explained in the text, securities in the last two categories are subject to haircuts and may not cumulatively account for more than 40% of a bank's HQLA.

At present, longer-duration Treasuries count as unlimited HQLA, based on current market value, while agency-backed MBS may count for up to 40% of total HQLA, with a 15% haircut off current market value.[33] However, from a social perspective, longer-duration securities are an inefficient way to back uninsured deposits. This is because longer-duration securities, even if they remain completely liquid, may have a lower market value in the bad state. Thus, a bank would have to hold $1/F_S$ units of long-term securities, rather than just one unit of T-bills, to prevent the same amount of socially inefficient fire-selling of loans. This in turn would crowd out more valuable lending ex ante, with no social benefit, since society is not obviously better served by having banks hold long-term securities as opposed to T-bills, even if bankers privately prefer the former.[34] Again, an important point here is that, from a social perspective, the intermediation of long-term securities can be more safely done in the bond-fund sector, where investors knowingly assume the interest-rate risk themselves, than with runnable uninsured bank deposits.

On the other hand, it is unrealistic to think that all banks could back their currently high levels of uninsured deposits with short-term Treasuries and reserves alone. To put this issue in perspective, there is currently about $8.3 trillion of outstanding Treasury debt that matures within the next 12 months (this includes $5.7 trillion of Bills and $2.6 trillion of short-term Notes and Bonds), along with about $3.5 trillion of reserves (a figure that is diminishing by between around $80 billion a month as the Federal Reserve continues its program of quantitative tightening). There are about $8 trillion of uninsured deposits. So, an average assumed runoff rate of 75% for uninsured deposits would require using more than half of all reserves and outstanding short-term Treasuries as backing, while an assumed runoff rate of 100% would consume around two-thirds of those two asset classes. Thus, as a practical matter, there is reason to allow longer-duration securities that carry essentially no credit risk.

To be clear, this simple calculation ignores equilibrium effects. In particular, imposing a more stringent form of the LCR on uninsured deposits will reduce the quantity of uninsured

[33] Other "Level 2" assets are also included in the 40% cap. So, if a bank has 35% of its HQLA in agency MBS, it will be able to count only up to 5% of HQLA any other qualifying Level 2 assets such as corporate and municipal bonds. These latter asset classes are subject to a 50% haircut and independently capped at no more than 15% of total HQLA.
[34] One reason bankers might have a private preference for long-term securities is that they have a term premium, which generates higher reported income (Hanson and Stein (2015)). To the extent that such a term premium is just compensation for risk, long-term securities are not a socially higher-NPV investment than short-term bills, but they may be attractive to managers whose incentives are to maximize reported earnings. Similarly, bankers might have private preference for MBS over like-duration Treasuries because MBS yields contain an extra option premium component that compensates holders for the fact that they are short a call option on interest rates.

deposits in the system, which we view as an entirely desirable outcome, especially to the extent that these deposits are funding long-term securities holdings. Moreover, as noted above, even holding fixed the quantity of uninsured deposits, there is a policy case for offsetting to some degree banks' incentive to back them with longer-duration securities. Thus, the banking agencies might want to consider tightening the current LCR limit of 40% that applies to agency MBS and imposing some form of limit on the portion of longer-term Treasury securities that can count as HQLA. Alternatively, a similar outcome might be achieved by subjecting eligible longer-term securities to a haircut that steeply increases with the duration of these securities.

Relationship of the Modified LCR to the Discount Window. Our model assumes perfect liquidity for both T-bills and longer duration securities. However, as observed during both 2008 and 2020, the immediate liquidity of even the safest assets can have limits during periods of serious financial dislocation. Moreover, as was evidenced during the bank panics in the spring of 2023, practical impediments such as the need to move collateral may stymie banks' attempts to access the Discount Window quickly when other avenues of funding have been closed off. For both these reasons, we believe that any required backing of uninsured deposits under a modified LCR, including T-bills, should be pre-positioned at the Discount Window.

With or without a requirement for pre-positioning, the question arises whether loans pre-positioned at the Discount Window should be credited for purposes of satisfying the LCR—both generally and for backing uninsured deposits in the kind of regime we propose. Of course, loans on the books of banks do not qualify as HQLA under the current LCR. But another way for a bank to generate liquidity at time 1—and hence to avoid fire sales of its loans—is to borrow from the Discount Window using these loans as collateral. In fact, as part of their liquidity management strategies, some banks already pre-position significant portions of their loan portfolios at the Discount Window. Thus, one might argue that the LCR should give banks credit for this LOLR access if they are willing to pre-position the loan collateral at time 0, and allow it to serve, in addition to T-bill holdings, as backing for uninsured deposits. Indeed, a recent report by the G-30 makes just that recommendation.[35]

To consider this possibility, we assume that the Federal Reserve, as lender of last resort (LOLR), is restricted to making loans at time 1 that are fully collateralized, i.e., loans that are

[35] Group of Thirty, Bank Failures and Contagion: Lender of Last Resort, Liquidity, and Risk Management (January 2024), available at https://group30.org/images/uploads/publications/G30_Lessons-23-Crisis_RPT_Final.pdf.

virtually certain to be fully repaid at time 2. If not, it would be taking non-trivial credit risk, something that the Federal Reserve is not legally authorized to do through its Discount Window lending under Section 10B of the Federal Reserve Act.[36] Accordingly, if a bank pre-positions loans in amount L at the Discount Window at time 0, it can count on being able to borrow only an amount $z_L L$ at time 1, where again, z_L is the worst-case value of the loans at time 2. Thus far we have assumed that $z_L = 0,$ implying that banks cannot use loans to collateralize any discount window borrowing at time 1.

However, the model can be easily extended to cover the case where $z_L > 0$ so that loans can be used to collateralize borrowing from the Fed at time 1. The analysis of Option 1 is identical to before. There is no need for LOLR borrowing at time 1, because all deposits are insured, and hence there are no runs. In Option 2, as long as $D_W > z_L L^* + F_S S^* + B^*$, the bank will be unable to fully pay off departing uninsured depositors just by selling its liquid assets and borrowing against its loans at the discount window. Rather, it will now have to liquidate a fraction Δ_L of its loans so that $\Delta_L k_L F_L L^* + (1 - \Delta_L) z_L L^* + F_S S^* + B^* = D_W$. In other words, the LOLR policy reduces the amount of fire-selling (i.e., Δ_L is now smaller all else equal), because some liquidity is obtained from the LOLR at time 1.

Similarly, in the strict LCR of Option 3, the bank does not need to hold as many bills as before in order to completely avoid fire sales. Now we only require that $z_L L + F_S S + B = D_W$. This allows for more lending ex ante, and yet still satisfies the requirement that the combination of liquid assets and Discount Window access be enough to pay off all uninsured depositors in the event of a run at time 1, without having to inefficiently liquidate any loans at this date.

Thus, the model suggests that it can be sensible to allow loans that are pre-positioned at the Discount Window to count towards satisfying an LCR for uninsured deposits, subject to an appropriate collateral haircut. This change would also accord with the policy aim of ensuring that banks are not excessively constrained by liquidity considerations from using higher proportions of their uninsured deposits for lending. Still, it is important to recognize that the issues associated

[36] Section 10B requires that any advances to member banks be "secured to the satisfaction" of the Reserve Bank making the advance. As reflected in the Federal Reserve's policies on Discount Window lending, this provision is understood to require sufficient collateralization to virtually guarantee that the Reserve Bank will be repaid in full. It is true that under Section 13(3) of the Federal Reserve Act, in "exigent" circumstances and with the approval of the Treasury Secretary and a contribution of "equity" by Treasury, the Federal Reserve may be able to establish lending programs that may not be fully collateralized. But ongoing liquidity requirements in normal times will not be a response to "exigent circumstances."

with setting an appropriate haircut on pre-positioned loan collateral would be very different, and considerably thornier, in the context of a regulatory requirement than those that arise in traditional Discount Window operations.

First is the question of the time horizon. If a bank approaches the Discount Window ex post, at the moment it needs to borrow, the haircut on collateral is set at the time the loan is extended. If, as is presently the case, a bank chooses to pre-position loans as a precautionary measure, it is doing so as part of its own business strategy. Here, by contrast, we are contemplating a situation where a bank is given ex ante regulatory credit for Discount Window borrowing that it might undertake at some later date, months or even years into the future. At this longer horizon, there is obviously a greater risk that the collateral will decline in value. In the language of the model, this is tantamount to saying that z_L is likely to be far below 1.

Indeed, it is possible that the prospect of a run is either prompted by concerns about the quality of a bank's loans or, even if a run is set off by other reasons, reveals that its loan book has been opaquely declining in value. In these circumstances, the ordinary response of requiring more collateral to compensate for the decline in value of existing collateral could exacerbate the already deteriorating liquidity situation of the bank. Alternatively, were the Federal Reserve to continue to promise availability at the original value of the loan collateral, it would effectively be taking on credit risk. Thus, haircuts for loans would have to be set more conservatively for LCR purposes.[37]

Second, the logistics of a regime in which allowing pre-positioned loans to meet LCR requirements could be daunting. Precisely because there are no readily identifiable market values for loans, as there are for traded securities, the Federal Reserve's schedule of collateral haircuts has very wide ranges for each category of loan.[38] The actual haircut imposed for any individual loan is determined by a model maintained by the Federal Reserve Bank of New York. Were loans pre-positioned at the Discount Window to be treated as HQLA, the complexity of this process might have to increase dramatically, with consequent increased risks of mistakes. Regular revaluation of all pre-positioned loan collateral by banks taking advantage of this new form of HQLA would, if taken seriously, be potentially much more burdensome—and imprecise—than

[37] It is important to note that this problem is not fully addressed by the Federal Reserve's current practice of repricing loans pre-positioned at the Discount Window on a monthly basis, presumably in calm circumstances when a bank could add more collateral. The problem of unknown or hidden losses would remain.

[38] For example, the haircut for a commercial real estate loan ranges from 44% to 95% of its estimated market value.

repricing securities with observable market values. In this sense, the qualitative argument in favor of a largely T-bill backed LCR remains similar to that above.

Finally, the inherent imprecision of setting haircuts at such longer horizons, combined with the heightened regulatory stakes at play, suggests that such a process may give rise to a great deal of lobbying and political pressure around what the appropriate value of the haircuts should be for various types of loans. In short, were the regulatory agencies to go down the road of counting pre-positioned loans as HQLA, we would urge them to proceed cautiously. They might, for example, begin on a relatively small scale—say by creating a new Category 2C form of HQLA that would be limited to a small percentage of total HQLA requirements. Over time, if experience with the valuation process gave confidence that a higher limit was prudent, an adjustment could be made.

B. Interest Rate Risk and Capital Regulation

In the above discussion, we have taken bank equity capital as exogenously fixed and focused exclusively on liquidity regulation. One conclusion has been that a well-designed LCR should lean against the use of long-duration securities as backing for uninsured deposits. Of course, interest-rate risk can also be addressed with capital requirements. The current risk-based capital regime does not do this for the banking book.[39] In fact, the U.S. banking agencies have only partially implemented the framework for supervisory oversight of bank management of interest rate risk originally developed by the Basel Committee on Banking Supervision in 2004 and updated in 2016.[40] Remarkably, the Federal Reserve's stress test scenarios in 2021 and 2022 did not include interest rate increases—something most observers would have identified as an obvious risk to the industry at that time.[41] Even without the broad evolutionary changes to the banking industry that we have highlighted, a more rigorous and complete coverage of interest rate risk in capital requirements would seem warranted. Those changes, though, considerably strengthen the

[39] Interest rate risk is considered in calculating risk-weighted requirements for the trading books of larger banks.
[40] In December 2023, the Basel Committee issued a consultative paper proposing further updates.
[41] In both 2015 and 2017, the Federal Reserve did include a significant interest rate change as a part of its "adverse" scenario. The Dodd Frank Act required at least three scenarios for annual stress testing—severely adverse, adverse, and baseline. The adverse, almost by definition, did not produce greater losses for banks than the severely adverse scenario, so was not the binding constraint on capital distributions. The Federal Reserve used the adverse scenario more as a source of supervisory information – testing the impact of quite different (rather than simply milder) scenarios on bank balance sheets. When Congress eliminated the requirement for an adverse scenario in 2018, the Federal Reserve eliminated it from the stress test.

case. As was painfully apparent in March 2023, large portfolios of longer-duration debt securities can meaningfully increase banks' vulnerability to significant changes in market interest rates.

Moreover, interest rate risk on the asset side interacts in an important way with factors that make deposits more likely to either reprice or run—with a lack of deposit insurance being an obvious such factor. Conventional wisdom has held that interest rate risk in the banking book was to some extent hedged by the stickiness of deposits. That is, although interest rate hikes reduced the present value of a bank's assets, this decline in asset value was offset by an increase in the value of the deposit franchise to the extent that the bank could retain most of its deposits, even if it increased the interest rate it paid on these deposits by only a fraction of the central bank's target rate increase. But if the deposit beta has increased, pressure on bank earnings and, eventually, capital, may build more quickly.[42] See Drechsler, Savov, Schnabl, and Wang (2023) for a recent analysis along these lines.

Going further, banks other than the very largest have not even been required to recognize unrealized changes in market value of their securities holdings—e.g., due to a rise in interest rates—in their regulatory capital metrics. This is due to "hold-to-maturity" accounting and the "AOCI opt-out" for securities that are accounted for on as "available-for-sale" basis.[43] [44] The banking agencies have now proposed to eliminate this AOCI opt-out for banks with assets between $100 billion and $700 billion. If this regulatory change is adopted, mark-to-market gains and losses

[42] The deposit beta is a measure of the sensitivity of the interest expense on a bank's deposits to changes in short-term money market rates (e.g., the Federal funds rate).

[43] Depending on the reasons they hold a security, banks account for their securities in three different ways under U.S. GAAP: "trading," "available-for-sale," or "held-to-maturity." Trading account securities are carried on the balance sheet at their current market value, so any mark-to-market (MTM) gains and losses impact book equity and flow through net income. Securities a bank intends to hold until maturity are recorded in the hold-to-maturity (HTM) account and are carried at their historical amortized cost. Fluctuations in the market value of HTM securities due to changes in level of interest rates do not impact the bank's book equity or its net income. Securities a bank might sell prior to maturity are recorded in the available-for-sale (AFS) account. AFS securities are carried at their current market value and fluctuations in MTM value of AFS securities impact book equity. However, unrealized MTM gains and losses on AFS securities do not impact net income and the retained earnings equity account. Instead, these MTM changes are recorded in a different equity account called "accumulated other comprehensive income" (AOCI) and are only recognized in net income if the bank sells the security, "realizing" the gain or loss. While "unrealized" fluctuations in the MTM value of AFS securities impact accounting book equity, the "AOCI opt-out" refers to the fact that, since 2013, U.S. bank regulators have allowed banks other than the very largest to ignore MTM changes in the value of AFS when computing their regulatory equity capital. Loosely speaking, regulatory equity capital is computed by starting with accounting book equity and then adding back (subtracting) the accumulated MTM losses (gains) on the securities a bank holds in its AFS account. This means that, while they differ for GAAP accounting purposes, there is almost no difference between AFS and HTM securities from the standpoint of regulatory capital.

[44] The very largest G-SIB banks already must pass through to capital any changes in the market value of their AFS securities. Until the Fed's 2019 tailoring regulation, *all* banks with over $250 billion were also required to do so.

on AFS securities will begin to impact the reported regulatory capital of mid-sized regional banks. We view this as a useful step in addressing interest rate risk, though it would probably be preferrable to have an explicit capital requirement for duration risk in banking book securities portfolios. Additionally, the regulatory agencies must decide how to treat securities designated as hold-to-maturity. It is unclear to what extent a change in rules applied only to the AFS book might be gamed by banks reclassifying AFS securities as hold-to-maturity.

Finally, unless the Federal Reserve's annual supervisory stress test is again applied to all banks over $50 billion, as was the case before a legislative change in 2018, even a regular stress test scenario focused on interest rate risk would miss many vulnerable banks. Thus, while we are aware of the prevailing view of regulators that a more generally applicable interest-rate risk rule is infeasible, we believe that the regulators should try again. If the effort proves unsuccessful, a second-best approach would be a structured supervisory program that regularly assessed the interest rate risk of all banks above a certain size threshold.

C. Merger and Competition Policy

Our analysis supports the view that changes in the industry have threatened the business model of many mid-sized regional banks. As such, our analysis has implications for bank merger policy, as well as prudential regulation.

Mid-sized banks risk being caught between, on the one hand, the scale economies of the largest banks and, on the other, the relationship-lending capacities of smaller regional and community banks. Increasing returns to scale have already been achieved through the standardization of credit analysis in most forms of consumer lending. In recent years, scale has also allowed the largest banks to invest substantial amounts in consumer-facing information technologies. As algorithms become more sophisticated and artificial intelligence enters into credit decision-making and other forms of risk management, size will likely be further rewarded since there are significant economies of scale in these sorts of IT investment. At the same time, community banks and smaller regionals are likely better positioned to take advantage of remaining opportunities for relationship lending and payoffs to localized knowledge, notably in lending to smaller businesses.

This characterization of the industry is reinforced by the trends we have identified—notably the changes in the portfolios of mid-sized regionals, with the decline in C&I lending and

the increase in securities holdings. These changes may leave these mid-sized banks in the uncomfortable position of having to rely very heavily on their deposit franchise—i.e., the ability to pay sub-market rates to their depositors—for a disproportionate share of their value creation. As was demonstrated in March 2023, the franchise value of this group of banks has likely been further eroded by the increasing ease and speed with which deposits can be moved across banks.

If our assessment is on target, the economics of the industry may lead to a significant deterioration in the competitive position of mid-sized regionals in the coming years. How this decline plays out will depend in significant part on the regulatory response. Will the federal banking agencies allow the capital, liquidity, and earnings positions of a set of increasingly uncompetitive banks to deteriorate? As the S&L crisis of the 1980s and early 1990s showed, such forbearance can end up being very costly for the economy and taxpayers. If, instead, the agencies maintain or increase regulatory rigor to prevent these banks from taking excessive risks in a desperate search for profits, then they may just stagnate. In that scenario, the business they lose will probably be captured by larger banks. The result would be a further increase in concentration of the banking industry.

In the face of these possibilities, it may be wise for bank merger policy to acknowledge these competitive dynamics and to look more positively on proposed mergers of mid-sized regionals and on acquisitions of smaller banks by mid-sized regionals. Whether these combinations can achieve the necessary scale for effective competition is hard to say in the abstract. But at least they would raise some prospect of industry consolidation that provides some competition for the largest banks. While a strict antitrust policy for the mega-banks is entirely reasonable, a similarly strict policy for the mid-sized regionals might—ironically—redound to the benefit of those same mega-banks.

VII. Conclusions

Our review of bank balance sheets over the last quarter century shows that, while uninsured deposits have become a greater share of bank liabilities, the information-intensive lending that dominates traditional views of banking has declined as a share of bank assets. While these trends on the deposit side might stall or reverse, the fact that they predated the Federal Reserve's policy responses to the Global Financial Crisis suggests that the rapid growth in total deposits—and the rising share of those deposits that are uninsured—are developments warranting attention from

regulators. Similarly, there are good reasons to believe that migration of business lending to non-bank institutions—especially lending to large- and medium-sized businesses—is likely to continue unabated.

One insight that emerges from the confluence of these two trends is that regulators may be more comfortable tightening liquidity requirements on uninsured deposits, insofar as the substantial increase in those deposit in recent decades has not been correlated with an increase in information-intensive lending. On the contrary, the two appear to be negatively correlated. A second conclusion is that the regulation of mid-sized regional banks may be especially in need of attention. As just noted, the business model of this group of banks looks increasingly vulnerable. At the same time, unlike the G-SIBs and the very largest regional banks, these banks are not currently subject to regulation and supervisory programs that account for the increased runnability of deposits.

Our effort here has been to provide some foundation for fashioning appropriate regulatory responses and some considerations to bear in mind in doing so. More work will obviously need to be done by researchers and regulators to calibrate and build out specific proposals.

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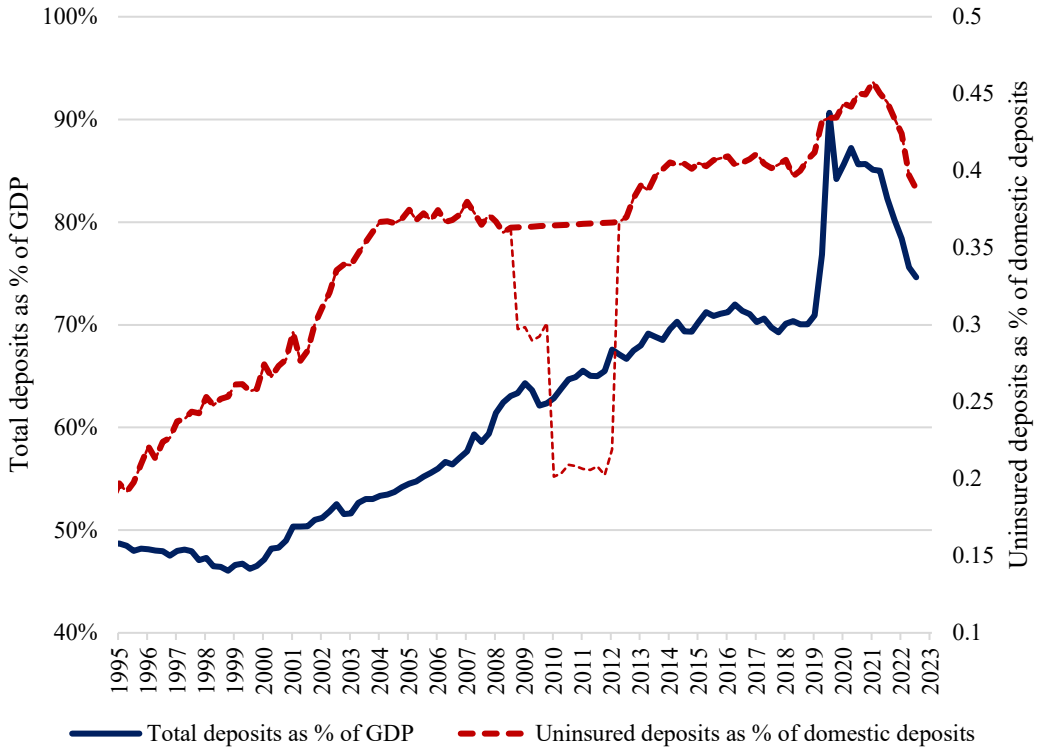
Figure 1: The Growth of Bank of Deposits

Figure 1A: Total deposits as a % of GDP and Uninsured deposits as % of domestic deposits

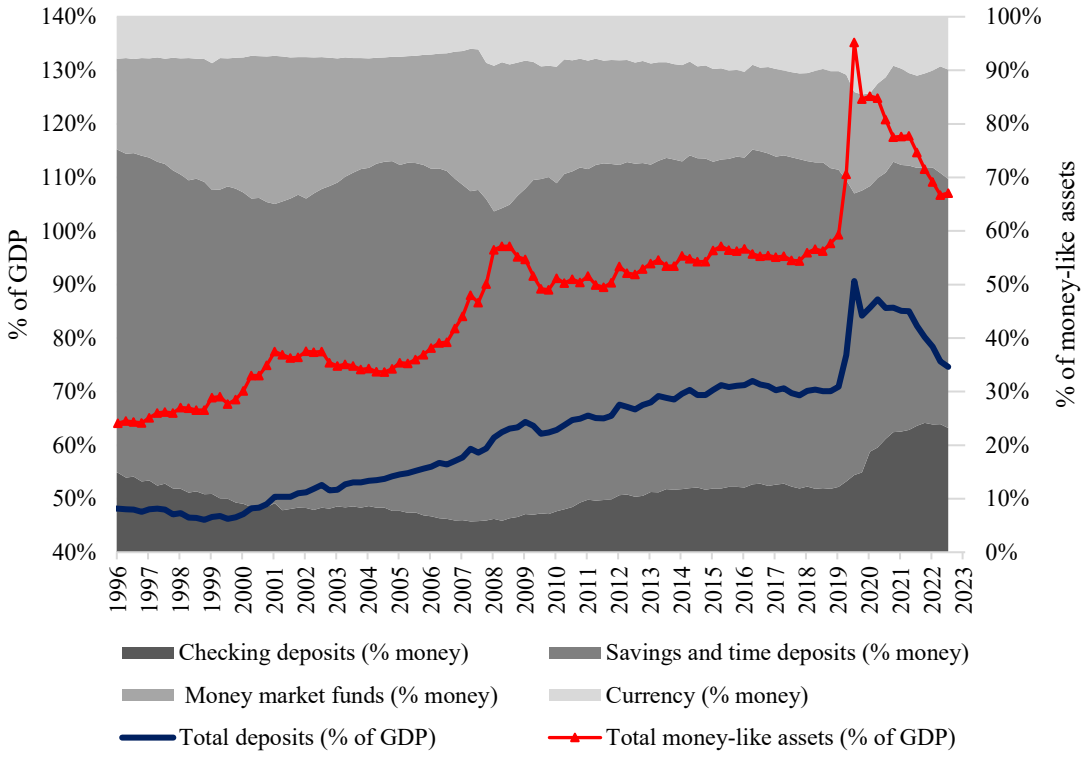


Notes: The solid blue line, which is plotted on the left axis, shows total deposits at U.S. depository institutions as a share of U.S. GDP. This includes the deposit liabilities of U.S.-chartered depository institutions, U.S. foreign banking offices, banks in U.S.-affiliated areas, and credit unions. The dashed red line, which is plotted on the right axis, shows the estimated fraction of domestic deposits that are uninsured at FDIC-covered institutions. For the uninsured share of deposits, we linearly interpolate the 2009Q3 to 2012Q4 values to remove the effect of the Transaction Account Guarantee program, which lowered the uninsured share by temporarily expanding deposit insurance coverage.

Source: Total deposits is from the Financial Accounts of the U.S. and equals the sum of total Checkable Deposits and Currency (FL793120005) and total Time and Savings Deposits (FL703130005) minus the currency liabilities of the Monetary Authority (FL713120005). Gross Domestic Product is from FRED. The Uninsured deposit share is from the FDIC's Quarterly Banking Profile.

Figure 1: The Growth of Bank of Deposits

Figure 1B: Total deposits relative to total money-like assets

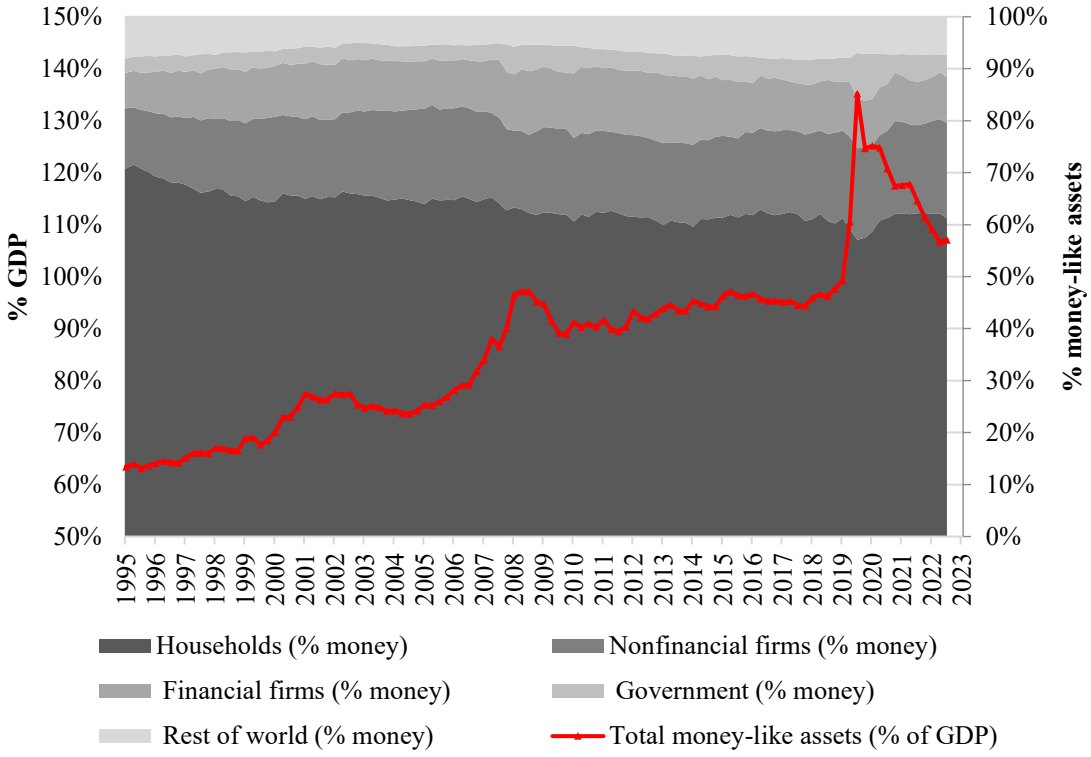


Notes: The solid blue line, which is plotted on the left axis, shows total deposits at U.S. depository institutions as a share of U.S. GDP. This includes the deposit liabilities of U.S.-chartered depository institutions, U.S. foreign banking offices, banks in U.S.-affiliated areas, and credit unions. The red line, also plotted on the left axis, shows how a broader measure of money-like assets—total deposits plus currency in circulation and money market fund shares—has evolved relative to GDP. The right axis shows the shares of these four money-like assets—checking deposits, savings and time deposits, money market funds, and currency—as a fraction of total money-like assets.

Source: Total deposits is from the Financial Accounts of the U.S. and equals the sum of total Checkable Deposits and Currency (FL793120005) and total Time and Savings Deposits (FL703130005) minus the currency liabilities of the Monetary Authority (FL713120005). Total money-like assets adds currency (FL713120005) and money market fund shares (FL634090005). Gross Domestic Product is from FRED.

Figure 1: The Growth of Bank of Deposits

Figure 1C: Holders of money-like assets

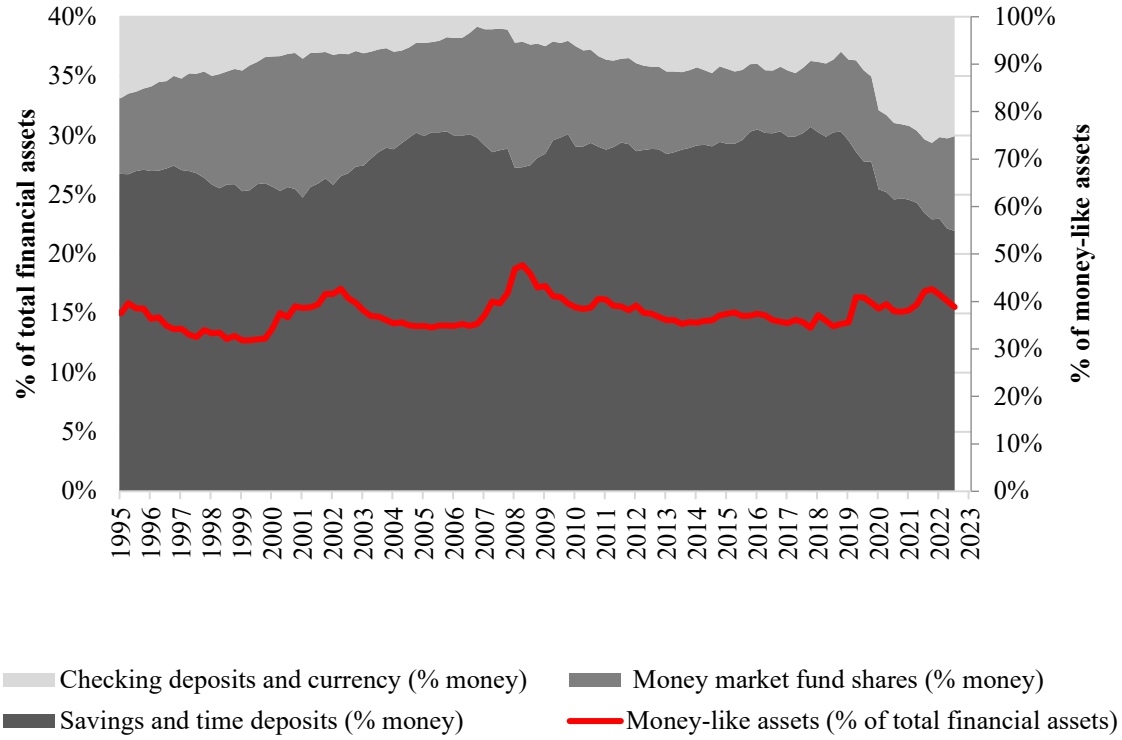


Notes: The red line, plotted on the left axis, shows a broad measure of money-like assets—the sum of checking deposits, savings and time deposits, money market fund shares, and currency in circulation—has evolved relative to GDP. The right axis shows the fractions of these money-like assets that are held by households, nonfinancial firms, domestic financial firms, federal, state, and local governments, and the rest of the world, respectively.

Source: Authors' calculations using data from Table L.204 (Checkable Deposits and Currency), L.205 (Time and Savings Deposits), and L.206 (Money Market Fund Shares) from the Financial Accounts of the U.S. Gross Domestic Product is from FRED.

Figure 1: The Growth of Bank of Deposits

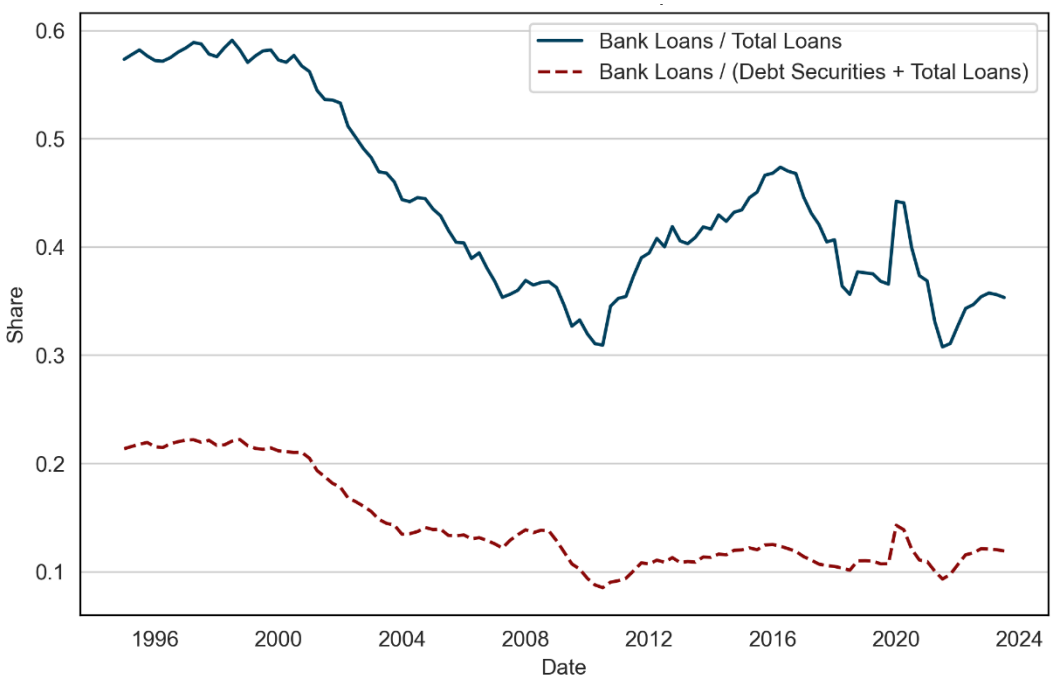
Figure 1D: Households' holdings of money-like assets as a % of their total financial assets



Notes: The red line, plotted on the left axis, shows households' holdings money-like assets—the sum of checking deposits, savings and time deposits, money market fund shares, and currency in circulation—as a fraction of the households' total financial assets. The right axis shows the fractions of these money-like assets that households holds in the form of checkable deposits and currency, time and savings deposits, and money market fund shares, respectively.

Source: Authors' calculations using data from Table B.101 (Balance Sheet of Households and Nonprofit Organizations) from the Financial Accounts of the U.S.

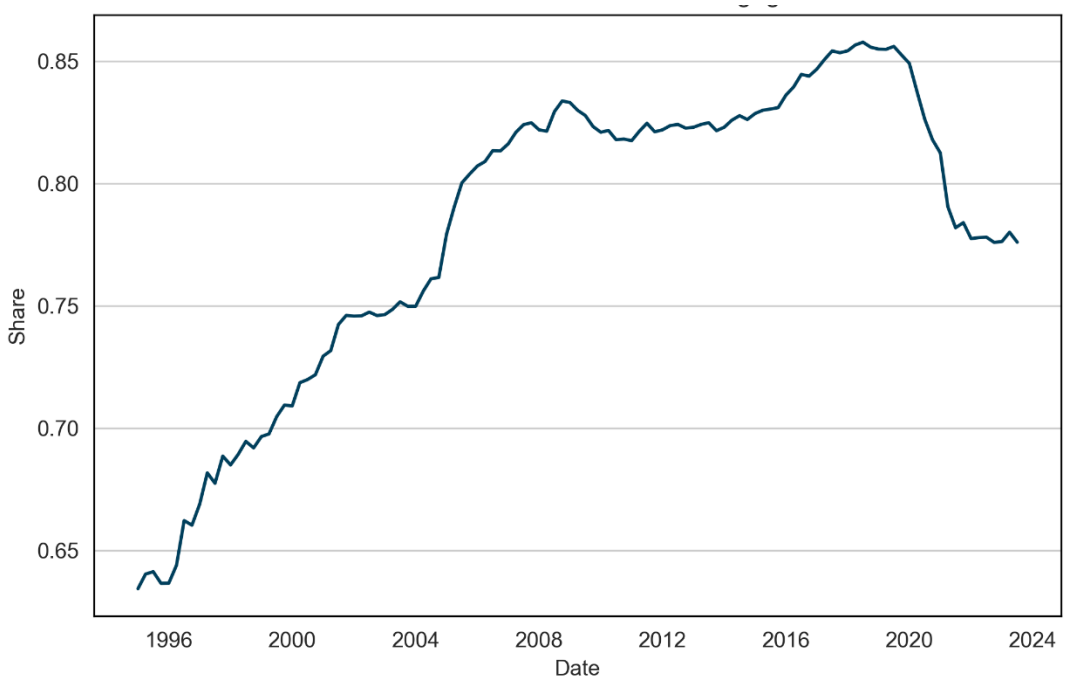
Figure 2: Bank Loans as Shares of Nonfinancial Corporate Liabilities



Notes: Using data from Table L.103 (Nonfinancial Corporate Business) from the Financial Accounts of the U.S., the solid blue line reports bank loans (excluding mortgages) as a fraction of total loans (excluding mortgages) to nonfinancial corporate businesses. The dashed red line adds corporate bonds to the denominator, plotting bank loans as a fraction of total loans plus corporate bonds.

Source: Figure compiled using data from the Flow of Funds (Federal Reserve Board of Governors), series FL103168005.Q (bank loans), FL104123005.Q (loans), FL103165005.Q (mortgages), and FL104122005.Q (debt securities).

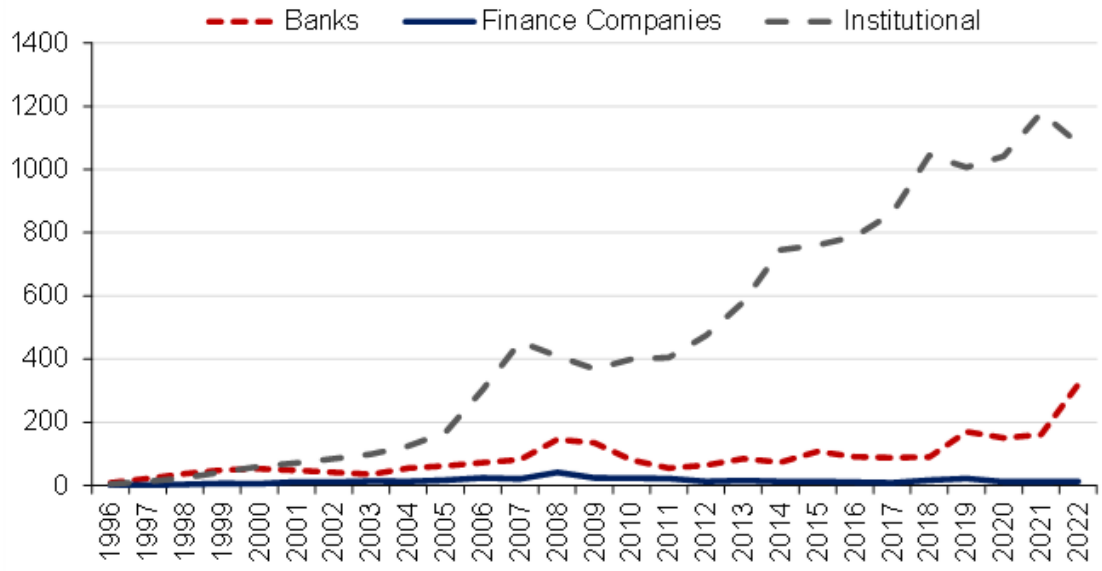
Figure 3: Bank Loans as Share of Nonfinancial Noncorporate Business Loans



Notes: Using data from L.104 (Nonfinancial Noncorporate Business) from the Financial Accounts of the U.S., the solid blue line reports bank loans as a fraction of total non-mortgage loans to nonfinancial noncorporate businesses.

Source: Figure compiled using data from the Flow of Funds (Federal Reserve Board of Governors), series FL113168005.Q (bank loans) and FL113169005.Q (other loans and advances).

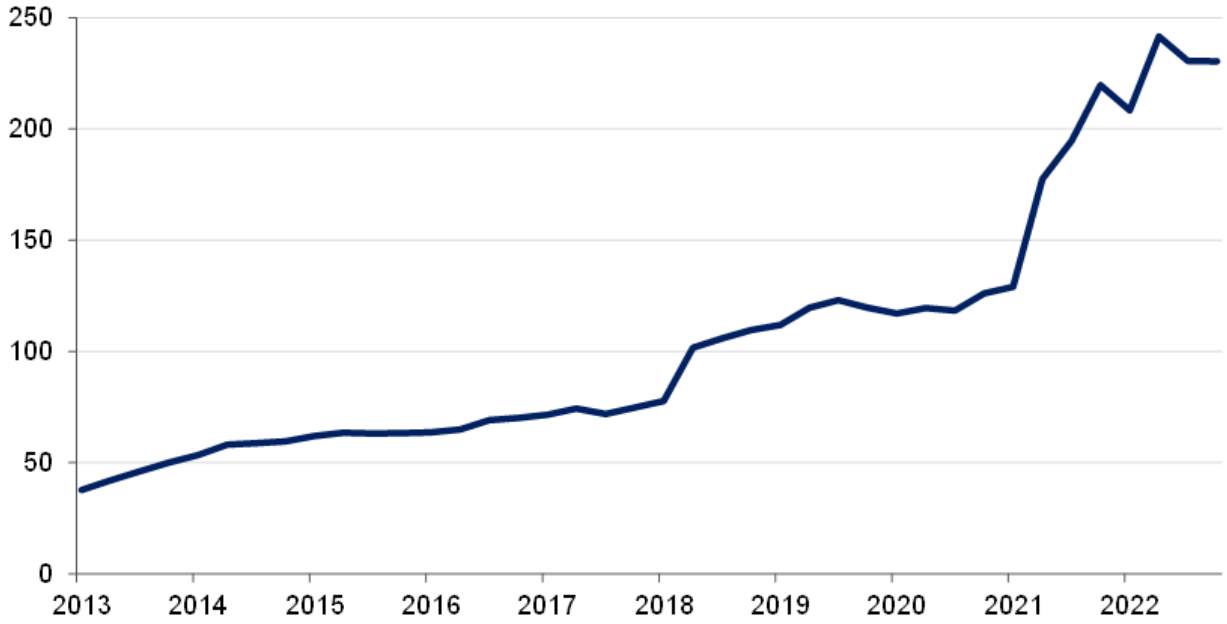
Figure 4: Leveraged Loans by Lender Type ($ billion)



Note: This figure plots outstanding U.S. leveraged loans by lender type from 1996 to 2022.

Source: Figure compiled using data from LCD and Pitchbook.

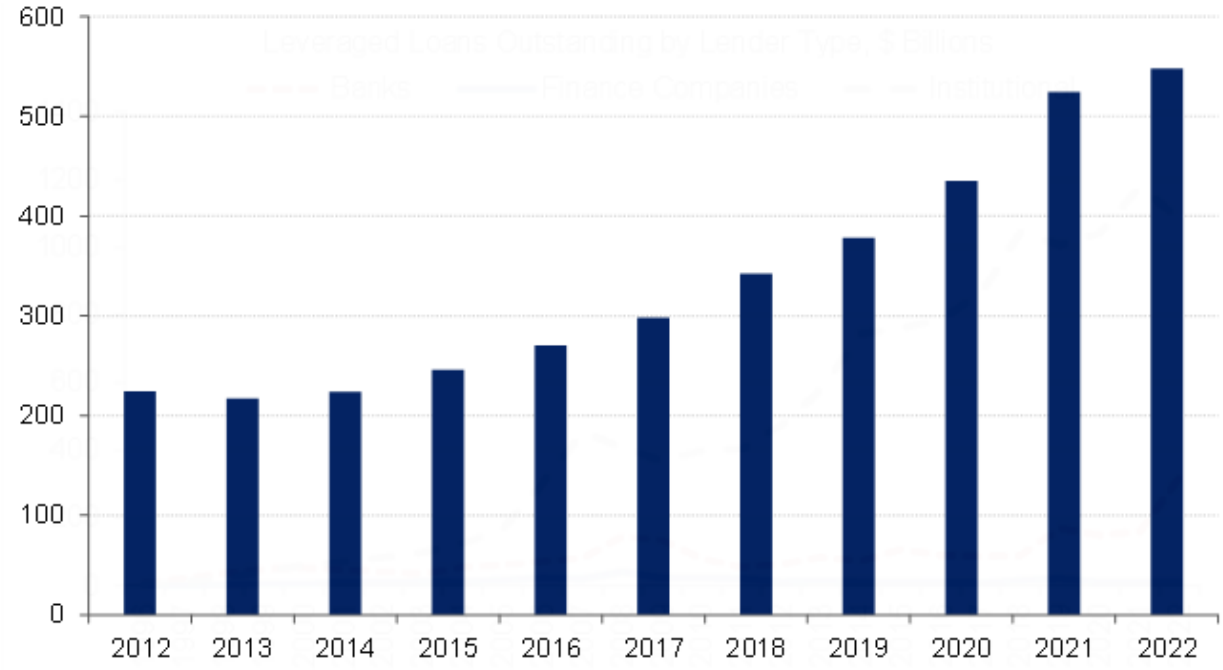
Figure 5: BDC Portfolio Holdings ($ billion)



Notes: This figure plots total loans held by Business Development Corporations (BDCs).

Source: Figure compiled using data from LCD and Pitchbook.

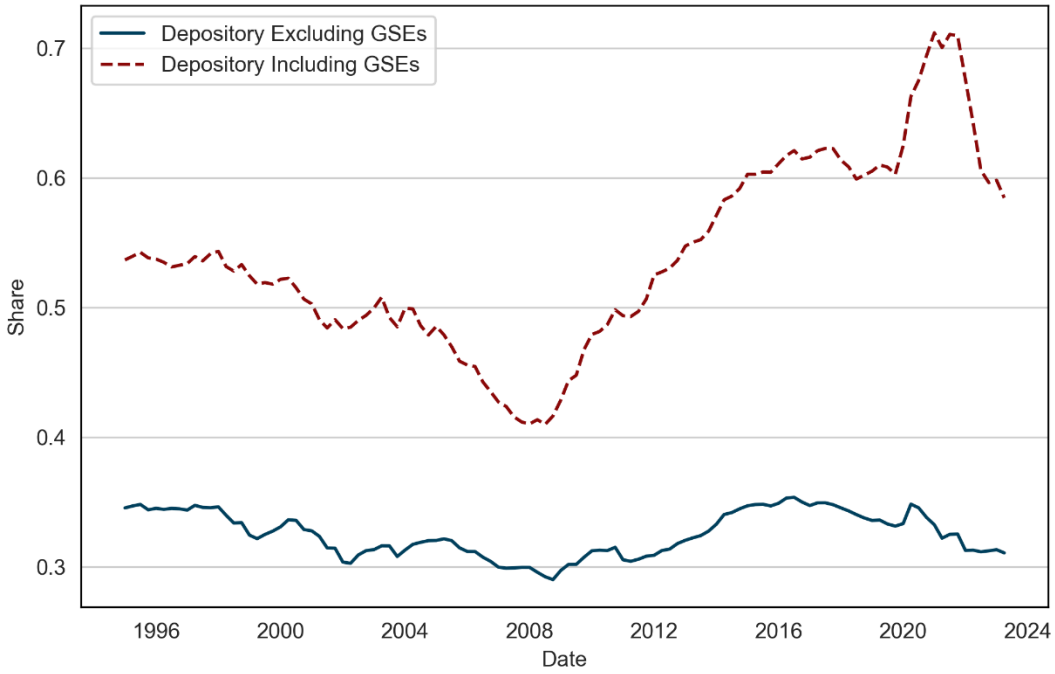
Figure 6: Deployed U.S. Credit by Private Credit Funds ($ billion)



Notes: U.S. values of private debt AUM are estimated using Pitchbook data on global private debt AUM and applying a rolling five-year average of the U.S. share of global fundraising.

Source: Figure compiled using data from Pitchbook.

Figure 7: Bank Share of 1-4 Family Residential Mortgages, Excluding Fed Holdings



Source: Source: Figure compiled using data from Flow of Funds (Federal Reserve Board of Governors):Table L.109 (Monetary Authority) series LM713061705.Q; Table L.110 (Private Depository Institutions) series LM703061705.Q; and Table L.218 (1-4 Family Residential Mortgages) series FL763065105.Q, FL893065105.Q, FL753065103.Q, FL743065103.Q, and FL473065100.Q.

Table 1: Bank Balance Sheet Shares Over Time

Share of Total Assets, All Banks							
Year	Loans	C&I Loans	C&I + CRE Loans	Cash + Securities	Cash + Sec < 3yr	Securities > 3yr	Reserves
2000	60%	17%	#N/A	27%	#N/A	#N/A	0%
2005	57%	11%	#N/A	28%	15%	13%	0%
2010	53%	9%	13%	30%	18%	12%	5%
2015	51%	12%	15%	36%	22%	14%	10%
2020	52%	13%	16%	35%	21%	14%	7%
2023	50%	11%	13%	38%	22%	17%	8%

Share of Total Assets, Banks <$100 Billion ($ 2023)							
Year	Loans	C&I Loans	C&I + CRE Loans	Cash + Securities	Cash + Sec < 3yr	Securities > 3yr	Reserves
2000	62%	14%	#N/A	32%	16%	15%	1%
2005	64%	11%	#N/A	29%	15%	14%	0%
2010	64%	11%	20%	28%	16%	12%	6%
2015	65%	12%	21%	29%	14%	15%	5%
2020	68%	13%	21%	24%	13%	12%	5%
2023	65%	12%	19%	28%	12%	15%	5%

Share of Total Assets, Banks $100+ Billion ($ 2023)							
Year	Loans	C&I Loans	C&I + CRE Loans	Cash + Securities	Cash + Sec < 3yr	Securities > 3yr	Reserves
2000	61%	20%	#N/A	24%	#N/A	#N/A	0%
2005	55%	11%	#N/A	27%	14%	12%	0%
2010	49%	9%	11%	33%	21%	12%	5%
2015	51%	13%	15%	35%	21%	14%	10%
2020	51%	14%	16%	36%	21%	15%	8%
2023	49%	12%	13%	39%	22%	16%	9%

Notes: "C&I + CRE" includes all commercial and industrial loans and loans secured by owner-occupied nonfarm nonresidential properties. The set of banks with over $100 billion in 2023 dollars in assets is not constant over time; it has grown over time as many banks have grown faster than inflation.

Source: Source: Figure compiled using data from Call Reports (FFIEC).

Table 2: Regression of Change in Bank Asset Shares on Deposit Growth from 2010 to 2023

	(1) Total loans	(2) C&I loans	(3) C&I & CRE loans	(4) Cash & Securities
Panel A: All banks				
Change in log deposits	3.572 (1.243)***	0.827 (0.575)	-0.808 (1.002)	-1.757 (1.079)
Observations	814	814	814	814
R-squared	0.030	0.006	0.002	0.007
Panel B: Large banks				
Change in log deposits	-8.386 (1.374)***	-4.479 (0.887)***	-0.576 (1.180)	6.709 (2.267)***
Observations	23	23	23	23
R-squared	0.259	0.229	0.003	0.194

Notes: This table reports regressions of the change in a bank's asset share from 2010 to 2023 on the change in log deposits over this same period. Panel A presents the estimates for all banks with assets greater than $1 billion in 2023 dollars. Panel B presents the estimates for large banks with assets greater than $100 billion in 2023 dollars. "C&I & CRE loans" includes all C&I loans plus loans secured by owner-occupied nonfarm nonresidential properties. Estimated at the regulatory high-holder or standalone bank level. Excludes Goldman Sachs, Capital One, Morgan Stanley, State Street, American Express Bank and Discover Bank. Standard errors are robust to heteroskedasticity.

Source: Call Reports (FFIEC).

Table 3: Cross-Sectional Regressions of 2023Q2 Asset Shares vs Uninsured Deposit Intensity

	(1)	(2)	(3)	(4)	(5)
	Loans	Cash & Securities	Cash & Securities <= 3-years	Cash & Securities > 3-years	Reserves
Uninsured Deposits/Assets	-0.133***	0.131***	0.072*	0.059*	0.052**
	(0.051)	(0.050)	(0.043)	(0.031)	(0.021)
Deposits/Assets	0.415***	-0.090	-0.309***	0.220***	-0.267***
	(0.113)	(0.112)	(0.096)	(0.036)	(0.076)
Observations	814	814	814	814	814
R-squared	0.073	0.018	0.071	0.053	0.141

Notes: The sample included all banks with assets greater than $1 billion in 2023 dollars. A 1-unit increase in the independent variable or dependent variable represents a 1 percentage point increase in the variable as a share of assets. Includes banks with at least $1 billion in assets ($ 2023). Excludes Goldman Sachs, Capital One, Morgan Stanley, State Street, American Express Bank and Discover Bank. Estimated at the regulatory high-holder or standalone bank level. Standard errors are robust to heteroskedasticity.

Source: Call Reports (FFIEC).

Table 4: Regression of Bank Market-to-Book on Deposit and Loan Characteristics

	(1) All banks	(2) Small banks
Avg. Deposit Rate (pp)	-0.343***	-0.320***
	(0.076)	(0.069)
Avg. Loan Rate (pp)	0.043	0.051*
	(0.027)	(0.027)
Log deposits	0.581***	0.655***
	(0.120)	(0.121)
Log loans	-0.121	-0.173
	(0.114)	(0.114)
Log branches	-0.096*	-0.115**
	(0.048)	(0.046)
Log noninterest expense	-0.394***	-0.404***
	(0.116)	(0.114)
Log employees	0.017	0.060
	(0.098)	(0.092)
Bank-year observations	3,304	3,137
Within R-squared	0.077	0.090

Notes: This table reports annual panel regressions of a bank's market-to-book ratio on its deposit and loan characteristics. The regressions include year fixed effects and are estimated over the 2010 to 2023 period. All regressions exclude banks with less than $1 billion in assets in 2023 dollars as well as Goldman Sachs, Capital One, Morgan Stanley, BNY Mellon, State Street, American Express Bank, and Discover Bank. All banks owned by the same bank holding company in a particular year are collapsed into a single observation. "Small banks" include banks with $1 to 100 billion of assets in 2023 dollars. Standard errors are clustered by quarter and bank holding company (i.e., regulatory high holder).

Source: Call Reports (FFIEC) and S&P Capital IQ.