October 21, 2020

Assessing Risks Related to Adding High Levels of Reserves to the Banking System[1]

I. Introduction

The Federal Reserve's actions to support financial market functioning and the flow of credit to the economy following the onset of the COVID-19 crisis have increased the size of its balance sheet by nearly $3 trillion to $7.1 trillion, and have increased reserve balances held by depository institutions (DIs) by about $1 trillion to a level of $2.9 trillion.[2] To date, the increase in reserves has been smoothly absorbed by the banking system, and after an initial period of volatility, money market rates have remained fairly stable at levels very close to the interest on excess reserves (IOER) rate.

As the Committee considers whether and how asset purchases should evolve to best support its maximum employment and price stability goals, it may be useful to examine how sizable purchases and resulting increases in reserves held by DIs could affect banks' balance sheets and money market rates.[3] With this backdrop, this memo assesses whether growing reserve levels could influence bank profitability or capital adequacy in a manner that could hinder banks' willingness to intermediate credit. The memo also discusses the impact of elevated reserves on banks' deposits and other liabilities and, in turn, on money markets more broadly and considers if any adjustments might be required to the current suite of policy tools to address any downward pressure on money market rates.

Staff reviewed two reserves growth scenarios in conducting this analysis. The first scenario involves a $2.5 trillion increase in reserves from current levels over a horizon of six quarters. This increase in reserves is broadly in line with the expected pace of asset purchases over the next six months as implied by the median expectation in the September Desk survey,

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[2] Values as of October 14, 2020. Changes in the Federal Reserve's balance sheet are calculated using the March 5, 2020 H.4.1 release.

[3] See Gust, Christopher, Antoine Martin, Zeynep Senyuz, and Patricia Zobel (2020). "Considerations for Asset Purchases," memorandum to the Federal Open Market Committee, October 16.

along with an assumption that the Treasury General Account (TGA) declines by $0.5 trillion.[4] The second scenario is more extreme and involves a $5 trillion increase in reserves over the same time horizon—a scenario that presumably would be associated with a severe economic downturn in which asset purchase and lending programs were substantially expanded. The $5 trillion scenario seems highly unlikely, but is intended to serve as a "severely adverse scenario" for the implementation of monetary policy, similar in spirit to the use of adverse scenarios in bank stress testing.

Overall, we conclude that banks would likely have sufficient capacity to absorb the increase in reserves in the $2.5 trillion scenario without significant pressures on their balance sheets and credit intermediation. Moreover, any downward pressure on money market rates that might result from banks reducing borrowing activity or lowering deposit rates, or from investors or households substituting to other money market instruments, could likely be managed by adjusting the parameters of existing, well-tested tools for rate control; specifically IOER and the offered rate under the overnight reverse repo (ON RRP) facility. In the more extreme scenario, with an increase of $5 trillion in reserves, banks may act more aggressively to limit the growth of reserves as a proportion of their balance sheets in an effort to improve profitability. These actions could put more significant downward pressure on money market rates, lead to reach-for-yield behavior in banks' assets portfolio or, in the case of banks whose leverage ratios became binding, reduce credit provision. In this scenario, policymakers could consider further adjustments to some of the parameters of existing tools—such as increasing counterparty limits or expanding eligibility for the ON RRP facility—or other alternatives—such as conducting asset purchases in a less reserves-intensive manner —to ease pressures on bank balance sheets and maintain healthy money market function and rate control.

The next two sections discuss the impact of reserves growth on banks and money markets if aggregate reserves were to grow by $2.5 trillion from current levels over the next year and a half, or by twice that amount. The following section reviews the suite of tools that could be employed to ease strains on intermediation channels and money markets, should they emerge, avoiding a situation in which large levels of reserves are counterproductive to macroeconomic goals. Finally, we describe the range of available data collections and intelligence gathering activities that can be utilized to detect emerging challenges for banks and money markets as reserve levels continue to grow.

[4] This latter assumption was influenced by the U.S. Treasury's August marketable borrowing estimate, which stated the TGA balance would fall by several hundred billion dollars by the end of the year. A more modest estimate has been selected given the quarterly refunding policy statement's guidance that balances may remain elevated until uncertainty about the passage of fiscal stimulus and other outflows diminishes. As of October 14, 2020, the TGA balance stood at roughly $1.7 trillion.

II. Significant reserves growth and banks' management of their assets and liabilities

We begin by discussing in general terms how banks may change their behavior in response to aggregate reserves growth. Next, we summarize how banks adjusted their balance sheets in the period of high reserves growth after the Great Financial Crisis (GFC), and how banks have so far responded to the current period of reserves growth. We then assess how an increase of an additional $2.5 trillion or $5 trillion in aggregate reserves could affect banks' balance sheets and optimization behavior.

Our analysis suggests that in the $2.5 trillion scenario, bank profitability and regulatory ratios would decline somewhat, but that banks should be able to offset these declines, especially if the economy continues to improve and loan demand picks up. In the $5 trillion scenario, profitability and leverage ratios could decline more significantly, providing stronger incentives for banks to adjust their balance sheets or change their business practices. Overall, given the larger pressures on banks' balance sheets in the $5 trillion scenario, as well as possible constraints on banks' ability to optimize in this scenario, it is less certain whether banks would be able to fully offset these pressures in the short term. Notably, however, outcomes in the $5 trillion scenario are especially uncertain given the unprecedented magnitude of the reserves change.

Bank optimization strategies in response to reserves growth

Bank reserves are typically the Federal Reserve liability that, in effect, "funds" the Federal Reserve's asset purchases at the margin. As the aggregate quantity of reserves grows, the banking system must adapt its business practices and balance sheet composition to accommodate the level of reserves.[5] In practice, aggregate bank balance sheets tend to grow as asset purchases generate increases in both reserves and deposits in the banking system, and subsequent bank adjustments tend to be gradual and occur along a continuum.[6] Because banks, in aggregate, must end up holding the quantity of reserves provided, the risk-adjusted return on alternative short-term assets that a bank may hold tend to be driven toward IOER—the rate of return on reserves. While this dynamic brings about the transmission of monetary policy to other

[5] The short-run effects of asset purchases can play out in a variety of ways. For example, in one polar case, asset purchases that correspond to the Fed buying securities from banks would increase reserves but would have no effect on the size of bank balance sheets. In another polar case, Federal Reserve asset purchases from households, and businesses, or from nonbank intermediaries both create reserves in the banking system and increase the aggregate size of banks' balance sheets. For more details, see Ihrig, Mize, and Weinbach (2017). In the longer-run, there may be endogenous responses that tend to reduce bank reserves and the size of bank balance sheets. For example, downward pressure on bank deposits may induce households to reduce deposits and hold more currency or to pay down loans at banks. Many other types of longer run endogenous adjustments are possible as well.

[6] As discussed in more detail below, aggregate reserves can fall under some scenarios. For example, if a drop in deposit rates spurs a migration of depositors to money market mutual funds that, in turn, invest those new balances at the Federal Reserve's overnight reverse repurchase facility.

rates and markets, the associated expansion of bank balance sheets may also lead to lower net interest margins and to lower Tier 1 leverage ratios and supplementary leverage ratios (SLRs) at banks, assuming capital is fixed.[7]

Banks attempt to optimize their asset and liability composition in response to reduced profitability or leverage ratio concerns arising from reserves growth.[8] Banks' optimization strategies can be categorized between those that have "scale" effects—bank actions that reduce the size of their balance sheets—and those that have "substitution" effects—bank actions that offset any undesired effect arising from greater proportions of assets held as reserves by shifting their portfolios to higher-yielding assets. Since the aggregate quantity of reserves is generally fixed, individual actions by banks to optimize their balance sheets will not reduce the overall quantity of reserves, but will affect market prices and the aggregate composition of banks' assets and liabilities portfolios over time.

A key optimization strategy in response to reserves growth is for a bank to reduce the size of its reserves holdings by allowing relatively expensive wholesale funding to mature without replacement or more generally to reduce deposit rates to discourage deposit inflows. Such a strategy represents a scale-effect strategy because it decreases the size of a bank's balance sheet all else equal. In the most recent Senior Financial Officer Survey (SFOS), banks noted that allowing wholesale funding to mature and lowering wholesale deposit rates, as well as reducing Federal Home Loan Bank (FHLB) funding, were highly likely actions that they would take to limit undesired increases in reserves, as shown in Figure 1. The general equilibrium effect of banks' deposit shedding behavior would tend to push deposit funding rates lower until the spread between IOER and deposit rates is wide enough to incent banks, in aggregate, to continue to hold the aggregate quantity of reserves. A similar effect would occur for other short-term interest rates as investors reduce their deposits while increasing their holdings of higher yielding secured or unsecured money market instruments. As overnight money market rates, including federal funds, fall below IOER, banks with capacity to grow their balance sheets would tend to expand reserves through borrowing in short-term funding markets so as to profit from the spread between IOER and short-term funding rates. For example, in the prior abundant reserves period

[7] Reserves receive a zero risk weight and, as such, only serve to lower the Tier 1 leverage ratio and SLR by entering the denominator in the calculation of the two ratios. While the Tier 1 leverage ratio is applicable to all banking organizations, the SLR applies only to holding companies subject to Category I, II, and III standards. Currently Treasuries and reserves may be excluded from the denominator of the SLR on a temporary basis. See https://www.federalreserve.gov/newsevents/pressreleases/bcreg20200401a.htm and https://www.fdic.gov/news/press-releases/2020/pr20060.html.

[8] Risk-based capital ratios are generally more binding for large banks than leverage ratios, and risk-based capital ratios have become more binding relative to leverage ratios recently due to the Federal Reserve's stress capital buffer rule.

U.S. branches of foreign banks (FBOs) absorbed some reserves that were shed by domestic banks.[9]

Another optimization strategy banks may pursue—and one that represents a substitution effect—is to seek to increase the yield on the rest of their asset portfolios given the increase in holdings of low-yielding reserves. Banks may first seek to reduce their holdings of low-yielding non-reserve high quality liquid assets (HQLA), such as Treasury bills and reverse repo secured by Treasury securities, as their reserves levels grow. To further boost net interest margins, banks could also substitute their excess reserves holdings for higher-yielding securities or loans. This behavior is a potential "portfolio balance" channel for monetary policy transmission through which increased reserves lead to lower interest rates and increased credit provision and, thereby, stimulates economic activity.[10] In the most recent SFOS, when asked about actions they may take to reduce reserve holdings should they see reserves growth through the end of the year, respondents (particularly GSIBs) responded that they would expect to purchase other Level 1 or Level 2 HQLA, as shown in Figure 2.[11] GSIBs are likely to also purchase other non-HQLA assets, but reported that, in the current environment, they would be more inclined to substitute higher-yielding securities for reserves rather than loans.

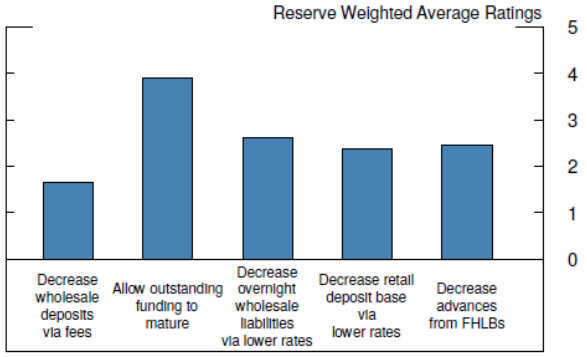
Growth in reserves that is not offset by other actions would affect bank leverage ratios more than risk-based ratios and could, in theory, raise overall Tier 1 capital requirements, perhaps leading banks to seek to raise additional preferred stock to offset declines in their leverage ratios. Further still, in the case in which banks' leverage ratios become binding and banks are not able or willing to raise additional capital to fund asset growth, banks may no longer be able to lend or grow past a certain level of reserves accumulation. It is important to note here that risk-based capital ratios are generally more binding for large banks than leverage ratios, and risk-based capital ratios have become more binding relative to leverage ratios recently due to the Federal Reserve's stress capital buffer rule.

[9] FBOs do not typically take FDIC-insured deposits and instead fund their activities through other short-term funding markets.

[10] Such behavior could also potentially reduce banks' resilience over time if reach-for-yield reduces prudent risk management. However, such credit growth would be constrained by banks' capital requirements with banks needing to hold enough capital as a fraction of their risk weighted assets.

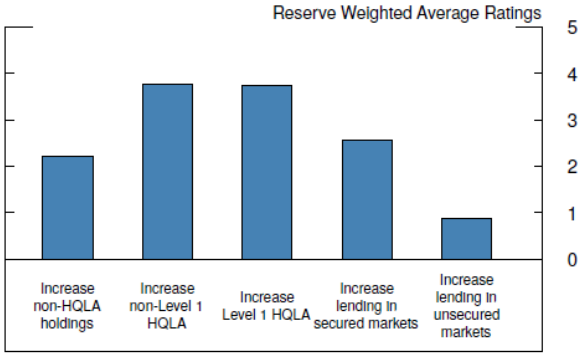
[11] Level 1 HQLA are the most liquid form of HQLA and include excess reserves and securities issued or guaranteed by the U.S. government. Level 2A assets include securities issued or guaranteed by a U.S. government-sponsored enterprise (GSE). Level 2B assets include riskier assets such as corporate debt securities.

Figure 1. Liability actions among SFOS banks expecting to take action to reduce reserves



Source: 2020 Senior Financial Officer Survey
Note: The vertical axis represents the reserve weighted average of the score SFOS respondent banks assigned to each action on a scale of 1 (least likely to use) to 5 (most likely to use).

Figure 2. Asset actions among SFOS banks expecting to take action to reduce reserves



Source: 2020 Senior Financial Officer Survey
Note: The vertical axis represents the reserve weighted average of the score SFOS respondent banks assigned to each action on a scale of 1 (least likely to use) to 5 (most likely to use).

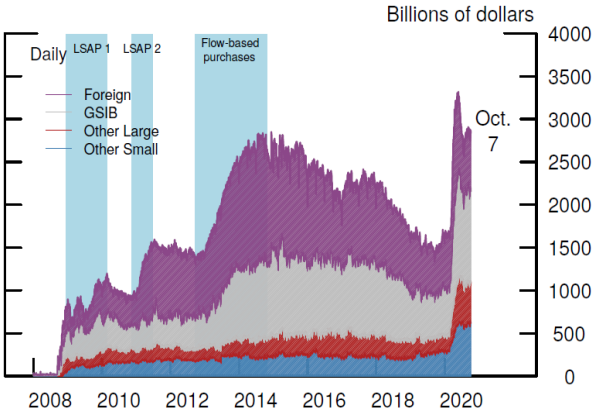
Bank behavior during previous periods of high reserves growth

During the period of high reserves growth associated with the Federal Reserve's large-scale asset purchases to support the economic recovery following the GFC, domestic banks lowered their deposit rates in an attempt to limit liabilities and reserves growth on their balance sheets. As short-term rates fell below IOER, branches of FBOs found it profitable to increase their deposits; indeed, FBOs eventually absorbed nearly half of the 2008 to 2014 increase in reserves in the banking system, as shown in Figure 3. This was the case even though FBOs account for less than 20 percent of total assets in the banking system. On the assets side of the balance sheet, domestic banks, however, did not sell Treasury holdings during the 2008 to 2014 period of high reserves growth as many banks were building liquidity buffers during this time to comply with new liquidity regulations. In the earlier part of the recovery, when loan demand was still relatively weak, the increase in reserves and securities holdings more than offset the drop in loans so that bank balance sheets continued to expand; as the economic recovery continued, lending volumes eventually picked up. Moreover, banks did not become constrained in their ability to make loans due to leverage ratio constraints since banks were actively also building their capital buffers during this time.

In the most recent episode of rapid reserves growth that began in March 2020, banks have so far absorbed both reserves and deposits smoothly. GSIBs and the largest domestic banks have absorbed a larger share of reserves growth than in the previous episode, and have appeared comfortable holding this higher level of reserves. Banks' aggregate non-reserves HQLA holdings have also not fallen as reserves have grown, as shown in Figure 4. Similar to the beginning of post-GFC economic recovery, loan demand has generally been weak and bank

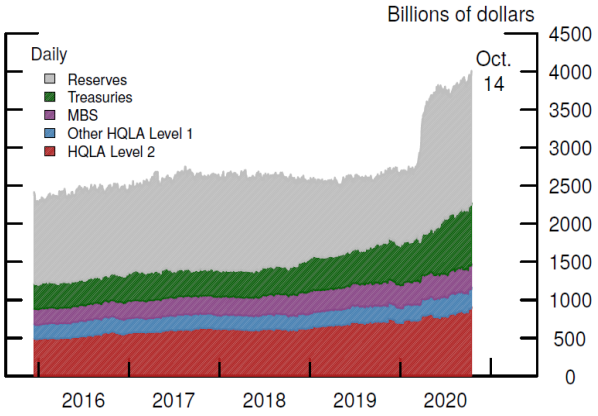
lending standards have been tighter since the onset set of the current crisis. Likely as a result, large deposit inflows have not led banks to increase their lending volumes.[12]

Figure 3. Distribution of Reserves Balances by Type of DI



Note: Foreign DIs consist of branches and agencies of foreign banks, as well as Edge and Agreement corporations. Other DIs consist of Thrifts and DIs that do not report on the FR 2900.
Sources: FR 2900, NRBL, FR 34

Figure 4. Selected HQLA at Banks Subject to the LCR



Note: Banks reporting include Bank of America, Bank of New York Mellon, Citigroup, Goldman Sachs, J.P. Morgan Chase, Morgan Stanley, State Street, Wells Fargo, UBS, Barclays, Deutsche Bank, and Credit Suisse.
Source: FR2052a, NRBL, EDDS.

Assessing the effects of an additional $2.5 trillion and $5 trillion in reserves on banks' behavior

Drawing on a range of inputs, we assessed the possible effects on banks' balance sheets of an additional $2.5 trillion and $5 trillion in aggregate reserves, where these effects include banks' behavioral responses to increased reserves. As reported in Appendix A, we estimated quantitatively how banks' balance sheets, profitability and leverage ratios could evolve under the $2.5 trillion and $5 trillion reserve growth scenarios using a set of simplified assumptions. We then assessed, in Appendix B, the optimization strategies discussed above and banks latitude to optimize, and with this assessment considered how our projections for bank balance sheets in Appendix A changed with these optimized strategies. Additionally, our analysis takes into account responses to the most recent SFOS.

It is important to note that the assessment here is based on a strong assumption that every dollar of Federal Reserve asset purchases leads, one for one, to increased deposits at banks and a corresponding increase in bank assets. As noted above, this need not be the case, especially over the longer run. The Federal Reserve's actions since March have increased the size of its balance sheet by about $3 trillion and reserve balances have only increased by $1 trillion. As a result, the estimates here of the effects of asset purchases on bank balance sheets likely represent an upper bound on these kinds of effects.

[12] Loan growth has generally declined in the second half of 2020 after an initial spike in C&I loans due to credit line drawdowns and loans granted under the Paycheck Protection Program (PPP). In the July 2020 Senior Loan Officer Opinion Survey on Bank Lending Practices banks reported both tighter lending standards and weaker demand across most loan categories. See Sapriza (2020) for more details.

Based on this assumption, our assessment suggests that in the $2.5 trillion reserves growth scenario, bank profitability and leverage ratios would decline somewhat, but banks should be able to offset these declines, especially if the economy continues to improve and loan demand picks up. However, it is important to note that the analysis assumes that FBOs eventually pick up a sizeable share of the increase in reserves, around 40 percent. If FBOs did not take up so much of the reserve balances going forward, even in the $2.5 trillion scenario, domestic banks may be faced with more balance sheet pressures, which could lead to more downward pressure on short-term interest rates. In the last crisis, FBOs had strong incentives to build their reserve positions and they faced limited costs in doing so.[13] In particular, in 2011, concerns about the European banking system resulted in increased demand among FBOs to demonstrate strong USD liquidity positions.

In the $5 trillion scenario, profitability and leverage ratios could decline more significantly. In this scenario, it is less certain whether banks would be able to engage in optimization behavior to fully offset balance sheet pressures or whether FBOs would be willing to hold the same fraction of reserves as in the past. Indeed, without a large enough spread between IOER and other funding rates, there could be a limit to the amount of reserves that FBOs would be willing to hold. As such, in the $5 trillion scenario, the analysis in Appendix A assumes that FBOs absorb only around 20 percent of the increase in reserves. Further, as highlighted in Appendix B, other factors may constrain banks' ability to optimize fully in the $5 trillion scenario, including internal risk management limits on the extent to which banks could add higher-yielding assets or loans to their balance sheets. In addition, if in the $5 trillion scenario demand for loans remained weak despite greater monetary policy stimulus, banks might find it challenging to offset the decline in their profitability from reserves growth by making more higher-yielding loans in the near term. Of course, over time as the economy recovered and loan demand returned, banks could begin to grow their balance sheets by making higher yielding loans to households and businesses, which would serve to eventually increase banks' profits.

III. Money market rates and rate control at higher reserve levels

As reserves grow and banks undertake balance-sheet optimization strategies to maintain profitability, they may scale back liabilities to limit balance sheet growth or seek to substitute reserves for other forms of HQLA. Both of these strategies have the effect of lowering short-

[13] FBOs may see some increased balance sheet costs to reserve accumulation, compared to that observed during the last period of reserve creation, as some FBOs are subject to capital ratios measured with the same frequency as U.S. banks. That said, most FBOs do not take retail deposits, and thus are not subject to FDIC insurance fees that are largely based on total balance sheet size. For this reason, FBOs may still see lower costs and higher returns to reserve accumulation than domestic banks when wholesale funding market rates are below IOER.

term interest rates relative to IOER.[14] The exact level of reserves at which banks would pursue these optimization strategies in sufficient scale to put downward pressure on rates is uncertain.

As in the previous section, we discuss what has been observed during previous periods of large increases in reserves —in this case in money markets— and assess how an additional $2.5 trillion or $5 trillion increase in reserves may impact money market rates and market functioning. Based on this review, we conclude that overnight funding rates are likely to fall farther below IOER in both scenarios. However, for the $5 trillion scenario, we assess that growth in reserves could lead to a level of overnight rates very close to zero even if IOER is placed closer to the top of the target range. The decline in rates to the bottom of the target range could, in turn, challenge the business models of money market mutual funds (MMFs) and would likely require adjustments to Federal Reserve tools to maintain a firm floor on money market rates. In addition, activity in certain unsecured markets, such as federal funds, could fall to very low levels.

Money markets during previous periods of high reserves growth

During the 2008 to 2014 period of high reserves growth, money market rates traded as much as 20 basis points below IOER as shown in Figure 5. With the growth in bank deposits, domestic banks lowered deposit rates to slow the growth of their liabilities, creating incentives for depositors to shift funds to money market mutual funds (MMFs).[15] MMFs facilitated a redistribution of reserves by lending in unsecured money markets to FBOs, who were willing to accept additional deposits at rates below IOER to then earn a spread by holding reserves at IOER or investing in other higher yielding money market investments.[16]

Short-term Treasury and repo rates followed unsecured rates lower as MMFs and banks, which allocated a higher proportion of their liquidity portfolios to these investments, increased lending activity in these markets. Banks reduced their reliance on certain wholesale funding markets and volumes in unsecured money markets, such as federal funds, fell. That said, these markets continued to operate effectively.[17]

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[14] In the most recent SFOS, when asked what actions banks are likely to take to reduce the level or growth of reserves for the remainder of 2020, 66 percent of respondents who expect to take action rated redeploying reserves into level 1 or level 2 HQLA as important, while 88 percent of these respondents selected maturing wholesale liabilities without replacement as an important way to change their liabilities.

[15] Foreign official accounts, also facing lower deposit rates at banks, shifted more funds into the Federal Reserve's foreign repo pool.

[16] Investments in FX swaps and foreign bank issuance of commercial paper also facilitated the redistribution of reserves.

[17] Although these risks did not materialize, an October 2019 BIS Markets Committee report, "Large central bank balance sheets and market functioning", noted that a prolonged period of low interbank trading activing could lead to weakened market discipline or "hysteresis" (loss of market knowledge and infrastructure).

To maintain rate control with higher levels of reserves, interest on excess reserves was implemented in 2008 and, in 2013, the ON RRP was introduced. These tools proved highly effective at maintaining interest rate control during this period. IOER helped lift overnight rates by encouraging banks to compete for deposits, and the ON RRP provided a broad range of money market lenders an outside investment option that improved their bargaining position with counterparties in private markets. The Federal Reserve was able to adjust IOER higher within the target range as needed to provide additional support for overnight rates. However, on quarter end dates, when FBOs managed the size of their balance sheets to lower levels, overnight rates fell further and the ON RRP take up increased.

In the spring of 2020, reserves grew to levels well above those observed in the post-GFC period following the rapid pace of asset purchases and usage of back-stop lending facilities.[18] To date, the increases in reserves have been absorbed smoothly. Overnight money market rates initially fell several basis points below IOER in late March; however, against the backdrop of historically high Treasury bill issuance, money market rates have since risen and remained stable, with the effective federal funds rate (EFFR) trading close to IOER.[19] In the near-term, money market rates are expected to remain near these levels.

Figure 5. SOFR and EFFR Spread to IOER

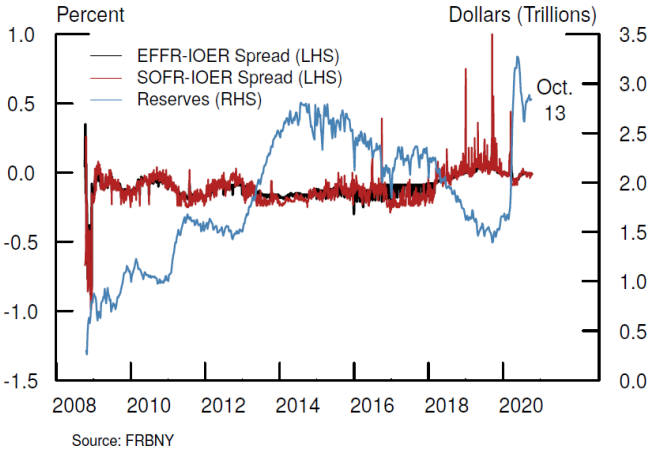
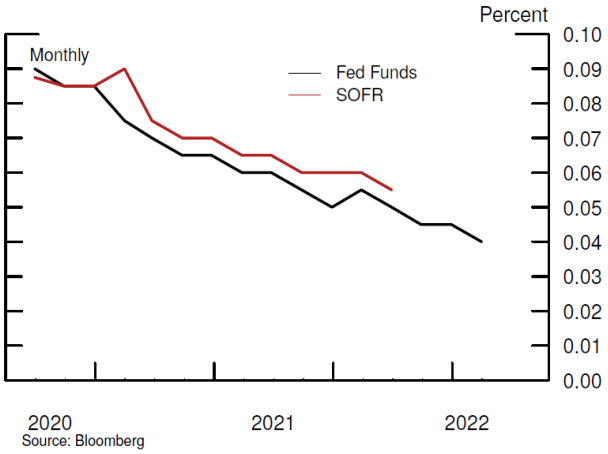


Figure 6. Futures Implied Rates



Assessing the effects of an additional $2.5 trillion and $5 trillion in reserves on money markets

Our assessment of a $2.5 trillion increase in reserves assumes that banks behave somewhat similarly to past episodes of elevated reserves levels. In this case, money market rates may fall more significantly below IOER, depending on banks' appetite to hold these additional

[18] Although aggregate reserve levels reached historic highs, total bank reserves as a percent of total bank assets were about three percentage points lower than the August 2014 peak. Source: H.6 and H.8 data series

[19] The stability of short-term money market rates also can be attributed to the expansion of the Open Market Trading Desk's repo operations and to significant Treasury bill issuance, which has counteracted the effects of higher reserve levels pressuring rates lower. Since June, Desk repos have been priced at back-stop rates, providing an effective ceiling when upward rate pressures emerge.

reserves. The Federal Reserve could implement "technical adjustments" to administered rates to keep the EFFR well within the target range.

The analysis suggests that some banks may limit their pace of reserves growth through reductions in more expensive forms of wholesale funding and lower rates on certain deposits. The resulting declines in money market rates could encourage some redistribution of reserves to banks that can profit from the reserves growth, such as FBOs. And MMFs may once again facilitate the redistribution by lending to FBOs in unsecured money markets or by investing in secured money markets.[20] That said, as many FBOs are now subject to similar capital ratios and other regulations that were put in place globally following the GCF, they may not be as incentivized to expand reserves to the same degree as in the past. In the absence of a technical adjustment to administered rates, money market rates could fall toward the bottom of the target range. MMFs and other lenders with access to ON RRP should be able to achieve returns somewhat above the ON RRP rate, preventing overnight rates from declining to, or below, the bottom of the target range on most days.[21]

Forward rates on money market instruments maturing through the end of 2021 suggest modest declines in overnight rates (Figure 6), likely reflecting market participants' expectations for continued increases in reserves as a result of asset purchases at the current pace plus some gradual decline in the TGA balance. Anecdotally, market participants have ascribed a high degree of uncertainty to this rate path, in part because the magnitude and likelihood of additional fiscal stimulus are in question. These factors influence forecasts for TGA balances and Treasury bill issuance, which in turn, influence money market rates.

The Federal Reserve's tools should continue to maintain good control over rates and money markets should continue to function smoothly even with rates near the bottom of the target range; however, at some point, ON RRP usage could rise. For example, reductions in bank borrowing activity on period-end dates could result in higher cash balances at MMFs, who would redeploy funds to the ON RRP. If FBOs and other banks become less willing to take reserves on non-period end dates, take up in the ON RRP could become more pronounced and persistent.

The $5 trillion scenario is likely to produce more significant downward pressure on money market rates and could present greater challenges to market functioning. In this scenario, banks may take more aggressive actions to reduce liabilities. Overnight funding rates are more

[20] This dynamic could be less pronounced relative to the 2008-2014 elevated reserves episode as MMF reforms implemented in 2016 may have curbed wholesale cash managers' appetite to use prime institutional money funds as vehicles for cash management, rather than bank deposits.

[21] Other market participants with access to Federal Reserve facilities could also negotiate overnight returns above zero in the private market. These include GSEs, which can deposit funds at the Federal Reserve without remuneration, and foreign and international monetary authorities with custody accounts at the Federal Reserve Bank of New York, which can leave funds on deposit unremunerated or in the foreign repo pool at the ON RRP rate.

likely to fall to the bottom of the target range as a result. In this scenario, FBOs might require a much larger spread to IOER in order to absorb additional reserves. If market participants are unable to invest funds at overnight rates above the ON RRP rate, primary dealers, MMFs and other eligible money market participants would shift funds to the ON RRP facility, draining reserves from the banking system. In some cases, ON RRP take up could become quite large, and adjustments to counterparty limits could be required to accommodate the demand to place funds.

While there may be policy benefits to having rates at the lower end of the target range given that the $5 trillion scenario would likely be associated with a very weak economy, rates near zero could give rise to some policy and market functioning considerations.

- MMFs may be challenged to operate profitably when rates are at or near zero, as they may not have sufficient return to charge fees and maintain shareholder values. MMFs are assumed to be a central actor in the reserves redistribution channel for the $2.5 trillion scenario; however, their investment opportunities could be hindered if secured and unsecured money market rates fall to near zero percent, as is presumed in the $5 trillion scenario.

- A stark shift in FHLB behavior could lead to a sharp contraction in activity in the federal funds market and, if significant and persistent, could ultimately call into question the robustness of the EFFR as a policy rate. FHLBs are the largest lenders in the federal funds market. Like other GSEs, FHLBs also have the ability to deposit funds at the Federal Reserve at zero percent. As overnight rates approach zero, FHLBs may favor a risk-free deposit to unsecured lending to commercial banks. If the robustness of the EFFR is called into question, the FOMC may want to evaluate its options for an alternative target rate.

- A wider spread between deposit rates and IOER could generate incentives for the establishment of banks that solely take deposits and hold reserves. In addition, should the ON RRP rate become relatively attractive, there could be an establishment of funds designed to invest primarily in the ON RRP.

IV. Overview of policy responses and alternative Federal Reserve liabilities

Should severe downward rate pressures or rate volatility emerge in short-term funding markets in response to significant reserves growth pressuring banks' balance sheets, the Federal Reserve has a number of options to maintain rate control and ease pressures on bank balance sheets. These include technical adjustments to administered rates, changes to the ON RRP facility design or use of other non-bank liabilities to drain reserves, modifications to asset purchases and exempting reserves from regulatory capital measures.

Adjustments to administered rates

Since the introduction of IOER, occasional adjustments to administered rates have been made to foster trading in the federal funds markets within the target range. Adjustments to administered rates and accessibility to the ON RRP have proven to be effective at maintaining rate control and supporting the functioning of money markets.

IOER has proven to be an effective anchor for short-term interest rates; however, various developments—including changes in reserves or changes in the amount of short-dated Treasury securities requiring financing—can lead the EFFR to drift above or below IOER.[22] As reserves continue to grow and bank balance sheet optimization strategies begin to place downward pressure on rates, policymakers may find that the current 10 basis point spread between IOER and the ON RRP rate might not provide sufficient incentive for some banks to accept additional reserves. A modest increase in the IOER rate is one way to provide this incentive. Money market rates have historically been highly responsive to technical adjustments in IOER, with the adjustment often fully passing through to money market rates the day the change takes effect.

The ON RRP has also served as an effective floor for EFFR. Under most circumstances, the ON RRP acts as an outside investment option for money market lenders, allowing them to negotiate more favorable overnight investment rates in secured and unsecured markets. However, in circumstances where banks require higher spreads to IOER to take on additional deposits or other money market rates decline, the ON RRP can serve as a "safety valve" in the financial system by providing a channel that can reduce deposit growth and reserves at banks. [23] On net, this migration of deposits from the banking system to money funds reduces aggregate reserves and deposits in the banking system and effectively shifts some of the "financing" of the Federal Reserve's asset purchases to MMFs.

In a more extreme scenario, such as the $5 trillion reserves growth scenario, the safety valve feature of the ON RRP could expand further by lifting the ON RRP rate above zero and perhaps closer to IOER. This smaller spread between administered rates could help facilitate the endogenous migration of deposits from the banking system to money market mutual funds in the event that reserve growth creates undue pressures on the banking system.

[22] See Martin, McAndrews, Palida and Skeie (2019).

[23] Recall that, for a given size of the Federal Reserve's balance sheet, every additional dollar in ON RRPs decreases the supply of reserves by a dollar, keeping all other liabilities the same.

Other adjustments to the parameters of the ON RRP program or other Federal Reserve liabilities

In very high reserves scenarios, there are steps the FOMC could take to enhance the ON RRP's ability to maintain interest rate control and to increase this safety valve effect of the program.

First, the FOMC could increase the current limit for ON RRP counterparties of $30 billion.[24] This could improve MMFs ability to negotiate better rates with borrowers and improve the ON RRPs safety valve feature. The counterparty limit has remained fixed since the facility was expanded in 2014. Since then, the MMF industry has grown considerably and is more concentrated. Increasing the ON RRP counterparty limit to align with the growth in assets held by MMFs could improve price discovery and expand reserve draining capacity when the facility is priced competitively.

The reserve draining capacity for ON RRPs would likely also increase if the set of counterparties were expanded. One way to expand counterparties is to reduce eligibility thresholds.[25] Another option is to expand eligibility to different types of counterparties. Beyond MMFs, other type of institutions could be considered as potential counterparties, such as securities lenders, smaller broker dealers, state and local governments, asset managers or corporations.[26]

Given that the ON RRP will likely be an important component of the implementation framework for the foreseeable future, staff could take a holistic look at program design, including the set of eligible counterparties, infrastructure currently employed (e.g., reliance on triparty), and other options to assess which, if any, enhancements could most effectively bolster the safety valve feature of the facility under different environments. ON RRP enhancements should be considered alongside the risks of disintermediating repo markets or becoming a lender of first resort in a credit crisis.

Similar to the possible expansion of ON RRP liabilities, the Federal Reserve could consider steps that would expand the role of other non-reserve liabilities and reduce aggregate reserves in the banking system. For example, in 2008—and as discussed in Appendix C—prior to the Federal Reserve Act amendment that allows interest to be paid on reserves, the Federal

[24] Increasing this limit by 50 percent would allow the ON RRP facility to backstop an additional $450 billion, 8 percent of MMF assets under management and expand ON RRP draining capacity by about 25 percent.
[25] Currently only MMFs with assets under management (AUM) above $5 billion or repo market activity above $1 billion are eligible counterparties. Lowering the AUM threshold to $1 billion, for example, would moderately increase the draining capacity of the ON RRP, allowing the ON RRP to backstop up to an additional $255 billion in MMF AUM (or 5 percent of total AUM).
[26] In the case of securities lenders, the Federal Reserves would have to sign agreements with each beneficial owner of securities, rather than their agents, who are large lenders in the tri-party repo market.

Reserve coordinated with the U.S. Treasury to issue "Supplementary Financing Program" (SFP) bills. The proceeds of Treasury bills issued under the SFP were held in a Treasury account at the Federal Reserve, thereby draining reserves from the banking sector. In addition, many central banks, such as the Bank of England, have the authority to directly issue "central bank bills" and maintain regular short-term issuance of these securities.[27] Central bank bills can be issued to a wide class of investors and can thus be used to manage the supply of reserves in the banking system.[28]

Adjustments to the asset purchases program

The FOMC could also consider reducing the flow of asset purchases and, thus, the pace of reserve creation, while maintaining a given level of accommodation. As described in the memo "Considerations for Asset Purchases," the FOMC could tilt ongoing asset purchases toward longer-dated securities to keep long-term yields low while decreasing the pace of asset purchases, thereby creating fewer reserves.

Alternatively, the FOMC could sell shorter-dated securities holdings while purchasing longer-dated holdings. For example, in 2012 the FOMC launched a reserve-neutral Maturity Extension Program (MEP). The MEP lowered longer-term interest rates through purchases of longer-dated Treasuries and sterilized the reserve creation with an equivalent amount of sales of Treasuries with less than three years to maturity. An MEP-like program is an option that the FOMC could consider, particularly in scenarios in which asset purchases and the associated reserve growth seemed to be placing significant pressures on bank balance sheets.

Adjustments to regulations

The Federal Reserve Board could consider extending the period for the current temporary adjustments to capital requirements that exempt reserves from leverage ratio requirements as a way to ease growing pressure on banks' balance sheets. A banking organization must hold a minimum amount of capital based on its size at both its insured depository institution and holding company-level. All banking organizations are subject to a leverage ratio of Tier 1 capital to total assets (Tier 1 leverage ratio), and large banking organizations are subject to a leverage ratio of tier 1 capital to on-and-off balance sheet assets (supplementary leverage ratio, or SLR).

[27] The Federal Reserve has sought authority to issue central bank bills in the past, but such proposals have not made much headway in Congress. See Allison and others (2009) for a discussion of the issues and challenges regarding the strategy of Federal Reserve Discount Notes. See Barger and others (2009) for a more general discussion of some of the possible policy responses to ease pressures on banks' balance sheets arising from high levels of reserves considered at the beginning of the post-GFC period of rapid reserves growth regarding strategies.

[28] From an operational perspective, issuing central bank bills is likely more effective and efficient than alternative methods of managing non-reserve liabilities.

Until March 31, 2021, reserves are excluded from the SLR for holding companies, and upon election, at insured depository institutions. The Federal Reserve Board could consider extending this temporary exemption if deemed appropriate to incent the largest banks to accommodate an increase in reserves of $2.5 trillion or $5 trillion. Any further change to the SLR requirement at the depository-institution level would require interagency coordination. An exemption from the Tier 1 leverage ratio would likely require Congressional action due to existing legal restrictions on amending that requirement. Moreover, additional adjustments to the leverage ratio requirements beyond the current exclusions to the supplementary leverage ratio would likely be accompanied by a discussion of whether other risk-free assets, such as cash, should also be excluded. Absent exemption of reserves from leverage ratio requirements, banking supervisors could communicate to banks that they would not view a decline in these ratios over time due to reserves growth negatively during periods of large-scale asset purchases.[29]

V. Monitoring for risks associated with elevated reserves levels

Staff are able to draw on various sources of information to monitor for bank appetite for reserves, drivers of softness in money market rates and risks to market functioning. Supervisory data, survey collections, results from open market operations, Federal Reserve balance sheet statistics, reference rate data collections, and real-time money market data can be employed to monitor for potential changes in reserves distribution, changes in banks' assets and liabilities composition, the sensitivity of money market rates to these shifts in behavior and any changes in market liquidity.

With respect to risks to banks' balance sheets and credit intermediation, supervisory staff have processes and data in place to monitor for risks such as reach-for-yield behavior or growing complacency surrounding liquidity risk management, and supervisory staff conduct regular outreach with banks. Likewise, System staff engage in regular financial stability assessments, including of the banking sector and of funding risk, using a variety of data sources and analytical approaches. In their regular monitoring of bank credit flows and lending standards, staff also monitor for any emerging signs of bank lending constraints. As reserves continue to grow, such regular monitoring work should highlight whether reserves growth may be affecting individual bank behavior, credit provision, and emerging trends and risks in the sector as a whole.

System staff would also monitor changes in reserves by bank and bank cohort as well as changes to asset composition at a high frequency. Further insights into banks' willingness to hold reserves and deposits can be gained from periodic SFOS surveys and ongoing dialogue with the banks' treasury functions.

[29] The Federal Reserve could also engage with the FDIC about whether reserves could be exempted from the deposit insurance fee calculation.

The Desk's collections of money market rates and volumes, money market fund assets and portfolio holdings, activity in open market operations and changes in non-reserves liabilities such as the foreign repo pool and GSE balances can also provide insights on whether reserves are being redistributed smoothly and whether risks to maintaining rate control may be growing. Frequent discussions with money market participants to better understand the factors impacting secured and unsecured money market rates supplement the data analysis. Furthermore, daily discussions with senior management and policy makers on Desk operations and rate control dynamics facilitate more rapid escalation of emerging risks.

VI. Conclusion

The Federal Reserve's aggressive policy actions in support of financial and economic conditions following the onset of COVID-19 crisis have led to record levels of reserves being created in the banking system. To date, banks have been willing to absorb large amounts of deposits and reserves, and money markets have remained stable with short-term interest rates near IOER. The continuation of asset purchases at the current pace for an extended period would substantially increase the level of reserves of the banking system. In response, banks may optimize their portfolios or attempt to manage their individual reserves holdings lower over time. Staff can monitor for these behaviors on an ongoing basis by analyzing a wide range of bank and market data collections and maintaining ongoing dialogue with banks.

Staff assessed the potential impact of an additional $2.5 trillion and $5 trillion in reserves on bank balance sheets and money market functioning. Banks would likely have sufficient capacity to absorb the increase in reserves in the $2.5 trillion scenario without significant pressures on their balance sheets and without significant downward pressure on money market rates. Any such pressures could likely be managed by adjusting existing, well-tested tools for rate control; specifically IOER and the ON RRP facility. In the more extreme scenario, with an increase of $5 trillion in reserves, banks may act more aggressively to limit the growth of their balance sheets and improve profitability. These actions could put more significant downward pressure on money market rates, lead to reach-for-yield behavior in banks' assets portfolio or, in the case of banks whose leverage ratios became binding or do not wish to further grow their balance sheets, reduce credit provision. In this scenario, policymakers, in addition to making a broader range of adjustment to administered rates, have additional tools including adjusting asset purchases to create fewer reserves, which should be adequate for maintaining rate control and preventing challenges to market function.

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Appendix A: Quantitative analysis illustrating how banks' balance sheets could evolve under $2.5T and $5T reserves growth scenarios

The analysis in this appendix illustrates the impact on bank balance sheets of an increase in bank reserves over six quarters from 2020 Q4 through 2022 Q1, using the 2020 Q3 level and distribution of reserves across bank categories as the starting point. The bank groups considered are GSIBs, other large banks (non-GSIBs over $100 billion in total assets), small banks (under $100 billion in total assets), and foreign (FBO) branches.[30]

The quantitative analysis assumes that the increase in reserves results in a dollar-for-dollar increase in bank assets funded primarily through deposits at domestic banks and a mixture of wholesale deposits and non-deposit liabilities at FBO branches. In the $2.5 trillion scenario, loans on banks' balance sheets are assumed to decrease in the first two quarters to pre-COVID levels and then grow at the remaining 4 quarters at a rate equal to the average growth rate between 2018 Q1 and 2019 Q4.[31] In the $5 trillion scenario, net loans will similarly decline in the first two quarters but a zero growth rate is assumed in the final four quarters, consistent with a worse macroeconomic outlook. The analysis assumes that the loan losses in the $5 trillion scenario are in line with those in the DFAST 2020 severely adverse scenario and that the path of Tier 1 capital is determined by the paths of net income and constant quarterly dividends.[32]

The assumed speed and scale of reserves expansion vary across bank groups, and reflects varying reserve management strategies and funding sources. Table 1 shows the assumed distribution of the increase in reserves, corresponding to the $2.5 trillion and $5 trillion scenarios. Over the projection period, FBO branches and GSIBs are assumed to absorb the highest amount of reserves in the $2.5 trillion scenario, and GSIBs and other large banks absorb most of the additional reserves in the $5 trillion scenario. Consistent with the discussion in the memo, the assumption on FBO branches' uptake of additional reserves reflects that these banks may increase their reserves holdings when system-wide reserves expand, as declining funding costs make IOER arbitrage more profitable.[33]

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[30] FBO branches refer to U.S. branches and agencies of foreign banks. Non-bank depository institutions are excluded from this analysis.

[31] Loans outstanding on banks' balance sheets dramatically increased in 2020 H1, and have since begun to decline in 2020 Q3 as precautionary borrowing on credit lines has subsided and PPP loan issuance has ended. Therefore, the assumption of loan growth gradually recovering from its negative 2020 Q3 growth rate translates into loan projections that is toward the lower end of possible outcomes.

[32] We calculate the path of net income using a projection of pre-provision net revenue minus loan losses, adjusted for taxes. Quarterly dividends are held at their 2020 Q2 level (the most recent quarter for which such data are available).

[33] However, total reserves at FBO branches are assumed to be capped at $1.7 trillion in the $2.5 trillion scenario, and at $1.5 trillion in the $5 trillion scenario. This assumption caps FBO branches' reserve balances by their peak historical reserves/loan ratio, to simulate limits to the willingness of FBO branches to expand their balance sheet with low money market rates.

In the $2.5 trillion scenario, the assumed distribution of reserves across bank groups is designed to reflect a gradual shift in the cross-sectional distribution of reserves across bank groups from the distribution observed at the end of 2020 Q3 to the distribution observed at the end of 2019, over the course of the six quarters. In the $5 trillion scenario, the first year of the projection period resembles the cross-sectional distribution of the increase in reserves observed over March – May 2020, with reserve holdings starting to shift towards the distribution observed at end-2019 in the last two projection quarters.

Table 1: Projected expansion in bank reserves in the $2.5T and $5T scenarios, by bank size group; 2020 Q4 – 2022 Q1

Bank group:	GSIB's		Other large banks		Small banks		FBO branches		Total	
Scenario:	$2.5T	$5T	$2.5T	$5T	$2.5T	$5T	$2.5T	$5T	$2.5T	$5T
Date:										
2020 Q4	197	242	149	169	294	292	92	119	732	822
2021 Q1	129	402	20	191	28	106	178	259	354	958
2021 Q2	126	479	9	228	23	126	195	309	354	1,143
2021 Q3	123	539	-1	258	18	151	213	154	354	1,102
2021 Q4	121	475	-11	222	13	139	231	0	354	837
2022 Q1	204	80	9	35	43	24	98	0	354	138
Total	900	2,217	174	1,103	419	838	1,006	842	2,500	5,000

Note: Values displayed are in billions of dollars.

Exhibit 1 shows the evolution of assets, reserves and core loans as a share of assets, and net interest margins (NIMs). [34] Additional reserves growth would expand banks' assets proportionally, and would also raise reserves' share and reduce core loans' share in assets,

[34] Interest rates on (non-reserve) interest-earning assets are assumed to be anchored by the evolution of the 3-month T-bill. The interest rate that banks earn on reserves is assumed to remain at the IOER rate observed in 2020 Q3, for the projection horizon. Interest rates on (non-deposit) interest-bearing liabilities are calculated as follows. The average rate on interest-bearing liabilities (calculated as the ratio of interest expense on interest-bearing liabilities and average interest-bearing liabilities) is calculated in the most recent quarter for which such data are available (2020 Q2). This rate is assumed to then gradually decline to the Tealbook-projected 3-month T-bill rate over three quarters in the $2.5 trillion scenario. In the $5 trillion scenario, this rate is assumed to decline over three quarters to the 3-month T-bill rate that is assumed in the DFAST 2020 "severely adverse" scenario. Interest rates on deposits are assumed to decline from the average rate on deposits (calculated as the ratio of interest expense on deposits over average interest-bearing deposits) to near zero (0.01) gradually by 2022 Q1 in the $2.5 trillion scenario. This average rate is assumed to decrease to near zero (0.01) faster, over three quarters, in the $5 trillion scenario, to be consistent with quicker interest rate declines under a more stressed macroeconomic scenario.

especially in the $5 trillion scenario where profitability (NIMs) at GSIB and other large banks would become challenged.

Exhibit 2 shows how the Tier 1 leverage ratio and the SLR would change at domestic banks, assuming they continue to pay dividends. The analysis suggests that, in the $5 trillion scenario, these capital ratios at the largest banks could become challenged. Lower capital ratios and reduced profitability could decrease banks' incentives to make loans, and increase their incentive to reach for yield.[35]

As discussed in the memo and detailed in Appendix B, domestic banks could utilize various optimization strategies that would mitigate these projected effects of reserves profitability and leverage ratios. These strategies would also alter the quantitative projections. Re-optimization on the liability side (including shedding deposits, reducing stable non-deposit sources of funding, or reducing expensive long-term debt) would yield relatively higher NIMs, and the Tier 1 leverage ratio and the SLR would decline by less than projected at the re-optimizing banks.[36] Re-optimization on the asset side (including reducing lower-yielding non-reserve HQLA or shifting into higher-yielding loans or securities) would yield higher NIMs than projected, but reach-for-yield strategies may further lower the SLR as loans and securities are not currently exempted from the denominator calculations.[37] If banks raise capital, for example through preferred stock issuance, the Tier 1 leverage ratio and the SLR would decline by less than projected.[38]

[35] Assuming less negative loan growth rates over the first three quarters of the projection horizon would translate into higher NIMs, leverage ratio and SLR projections.

[36] Compared to the quantitative projections in Exhibit 1, these actions would mitigate the expansion of reserves and reduction of core loans as a share of assets. If at the same time deposit rates fall (as is assumed in the analysis), fees on deposits increase and asset growth slows, NIMs and regulatory ratios would be higher than projected. Compared to the quantitative projections, a decline in deposit rates and growth in reserves at FBO branches in excess of what is assumed would translate into higher asset growth, as well as a higher expansion of reserves and more decline in core loans as a share of assets at these banks.

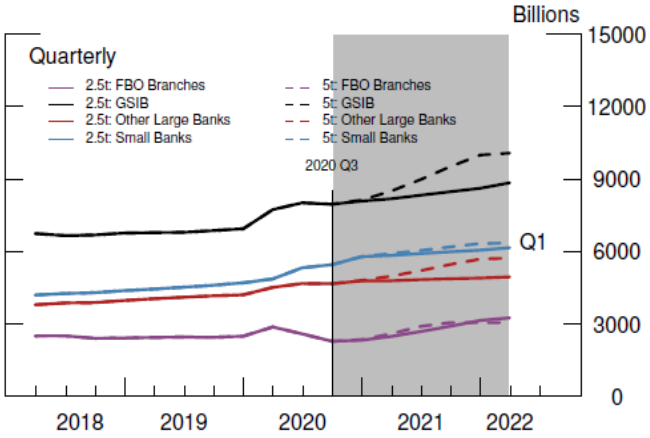
[37] These strategies, similar to those discussed on the liability side, would lead to slower growth of the balance sheet than is assumed in the quantitative projections, with reserves' share in assets increasing less. Core loans' share may even increase if banks shift into higher-yielding loans.

[38] Banks may limit the growth of their balance sheet by reducing the provision of credit or selling securities. In this case, in addition to lower asset growth, core loans' share in assets may decline by more than projected in Exhibit 1. Compared to the projections in Exhibit 2, the effect these strategies on regulatory ratios depends on whether the net income impact of the loan and securities sales on Tier 1 capital offsets the effect of slower asset expansion.

Exhibit 1

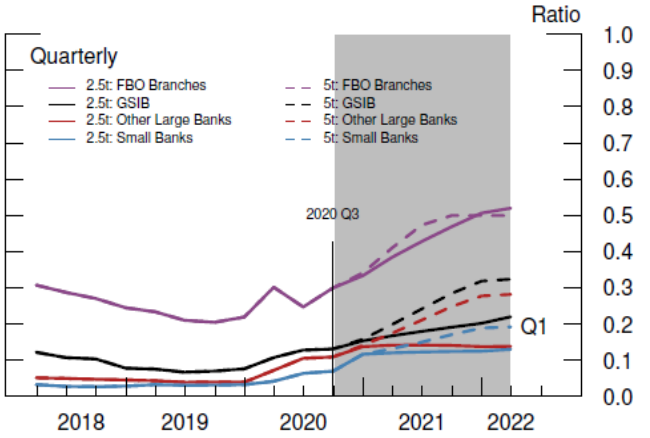
Bank asset composition and profitability

Total assets



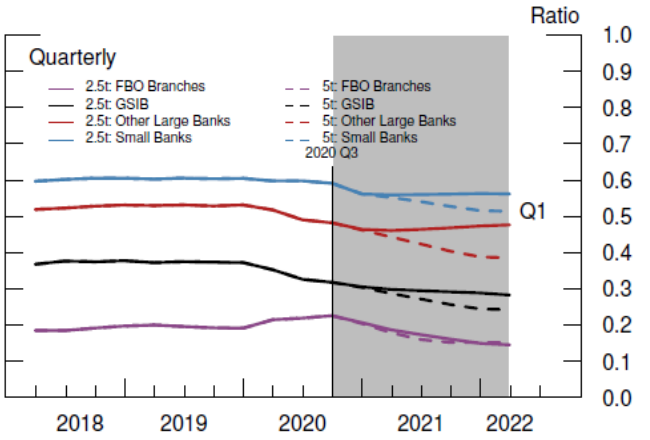
Source: top holder aggregated call reports data.
Note: 2.5T and 5T refer to the addition of 2.5 trillion dollars and 5 trillion dollars in bank reserves over the 2020 Q4 - 2022 Q1 period, respectively.

Reserves in total assets



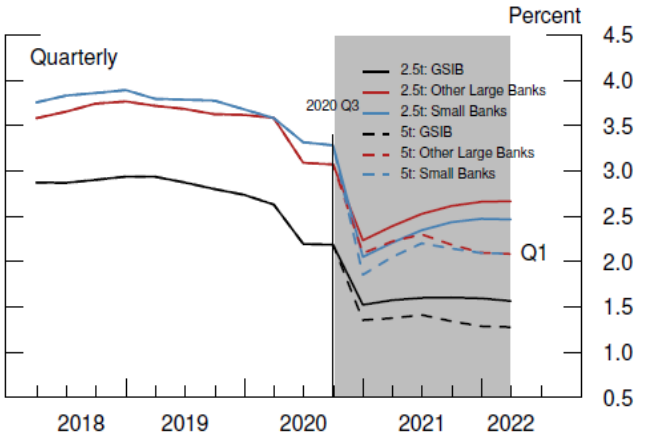
Source: top holder aggregated call reports data.
Note: 2.5T and 5T refer to the addition of 2.5 trillion dollars and 5 trillion dollars in bank reserves over the 2020 Q4 - 2022 Q1 period, respectively.

Core Loans in Total Assets



Source: top holder aggregated call reports data.
Note: 2.5T and 5T refer to the addition of 2.5 trillion dollars and 5 trillion dollars in bank reserves over the 2020 Q4 - 2022 Q1 period, respectively.

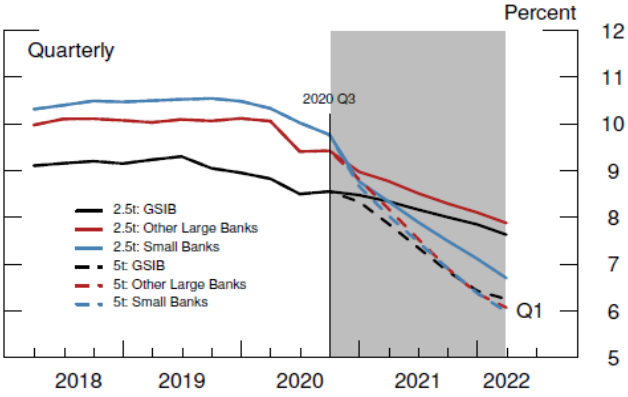
Net Interest Margin



Source: top holder aggregated call reports data.
Note: 2.5T and 5T refer to the addition of 2.5 trillion dollars and 5 trillion dollars in bank reserves over the 2020 Q4 - 2022 Q1 period, respectively.

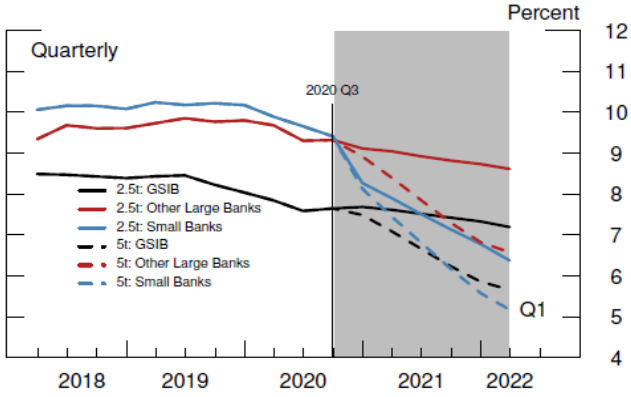
Exhibit 2
Regulatory ratios

Tier 1 leverage ratio: 2020 Q2 dividends



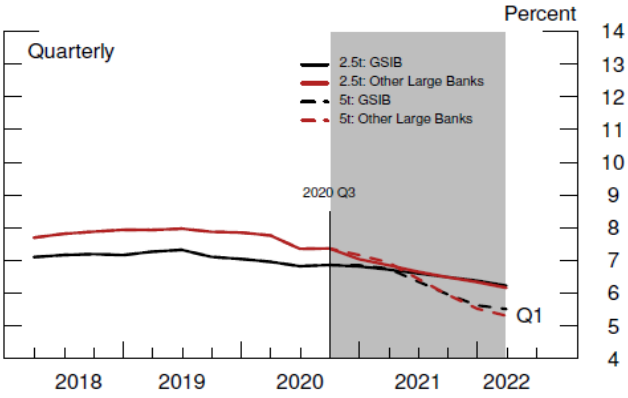
Source: top holder aggregated call reports data.
Note: 2.5T and 5T refer to the addition of 2.5 trillion dollars and 5 trillion dollars in bank reserves over the 2020 Q4 - 2022 Q1 period, respectively.

Tier 1 leverage ratio: 2020 Q2 dividends (BHC Level)



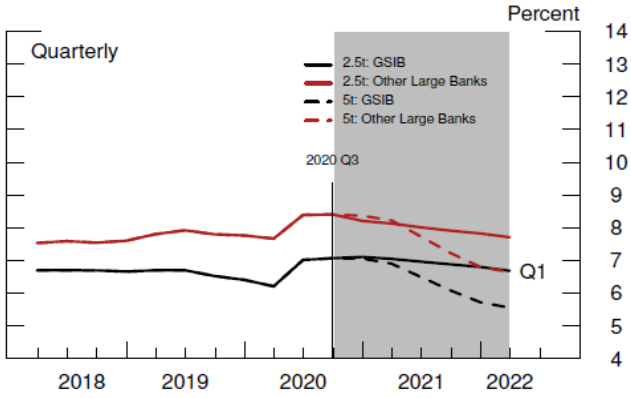
Source: FR Y-9C.
Note: 2.5T and 5T refer to the addition of 2.5 trillion dollars and 5 trillion dollars in bank reserves over the 2020 Q4 - 2022 Q1 period, respectively.

Supplementary leverage ratio: 2020 Q2 dividends



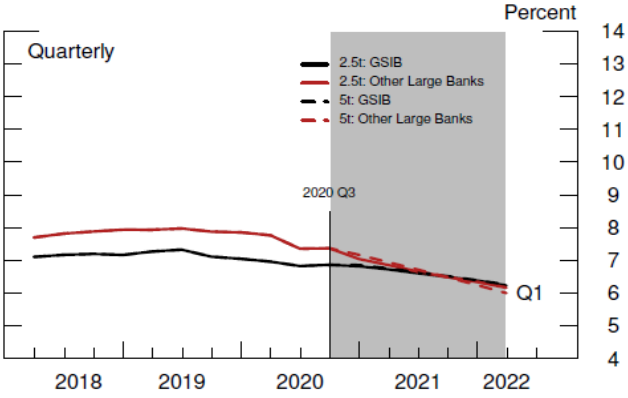
Source: top holder aggregated call reports data.
Note: 2.5T and 5T refer to the addition of 2.5 trillion dollars and 5 trillion dollars in bank reserves over the 2020 Q4 - 2022 Q1 period, respectively.*

Supplementary leverage ratio: 2020 Q2 dividends (BHC Level)



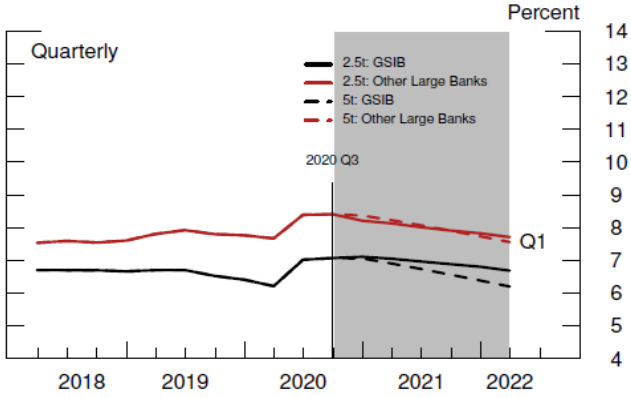
Source: FR Y-9C, FFIEC 101.
Note: 2.5T and 5T refer to the addition of 2.5 trillion dollars and 5 trillion dollars in bank reserves over the 2020 Q4 - 2022 Q1 period, respectively.*

Supplementary leverage ratio, with regulatory exemption renewal: 2020 Q2 dividends



Source: top holder aggregated call reports data.
Note: 2.5T and 5T refer to the addition of 2.5 trillion dollars and 5 trillion dollars in bank reserves over the 2020 Q4 - 2022 Q1 period, respectively.*

Supplementary leverage ratio, with regulatory exemption renewal: 2020 Q2 dividends (BHC Level)



Source: FR Y-9C, FFIEC 101.
Note: 2.5T and 5T refer to the addition of 2.5 trillion dollars and 5 trillion dollars in bank reserves over the 2020 Q4 - 2022 Q1 period, respectively.*

*Note: In addition to GSIBs, the supplementary leverage ratio applies to holding companies that have over $250 billion in total consolidated assets, or have over $100 billion in total consolidated assets and over $75 billion in a risk based indicator (including cross-jurisdictional activity, nonbank assets, weighted short-term wholesale funding and off-balance sheet exposure).

Appendix B: Bank optimization strategies in response to aggregate reserves growth and measures of optimization capacity

This appendix provides further detail on possible bank optimization strategies in response to reserves growth and provides estimates of banks' optimization capacity in light of the $2.5 trillion and $5 trillion reserves growth scenarios considered in the memo. The potential bank responses and trade-offs highlighted in this appendix are based on supervisory observations from 2008 through 2014 when there were significant increases of reserves in the system, and on information gathered from supervised firms based on recent COVID-19 monitoring work. It is worth noting that the regulatory and macro environment and causes of the crisis today are different from the past, and banks may respond differently.[39]

On the liability side, banks may make adjustments by reducing more expensive forms of contractual funding and modifying pricing on customer-driven liabilities, an example of a scale-effect strategy discussed in the memo. These adjustments would aim to offset lower asset yields and discourage growth in liabilities that are subject to higher regulatory costs and have limited franchise value. Specific examples include:

- Banks may reduce interest paid or charge fees on non-operational deposits to manage down balances. These deposits are treated less favorably in liquidity regulations such as the LCR and the short-term wholesale funding component of the GSIB surcharge, which can consequently impact the stringency of a bank's regulatory requirements,[40] and generally provide limited franchise value.
- Banks may reduce FHLB advances or other longer-term contractual liabilities in the DI subsidiary as well as long-term debt issued by the parent holding company.
- Banks also may reduce expensive long-term debt at the BHCs, leaving non-bank entities with a BHC more vulnerable to funding shocks.
- If domestic banks take actions to shed deposits or reduce other wholesale borrowing, these actions could put downward pressure on short-term rates. If rates fall sufficiently to make deposit taking attractive to U.S. branches of foreign banks (FBOs), they may step in to absorb expansion in reserves through increased usage of short-term wholesale funding markets from concentrated sources of credit-sensitive investors. This would come in the form of certified deposits and commercial paper transactions, or direct

[39] Banks' optimization behavior would likely happen on a gradual basis along a continuum, and there will likely be significant shifts in banks' asset allocation and liability composition over time, both as a result of this optimization process and the knock-on effects of reserve creation on relative market prices.

[40] For example, firms with $75 billion or more in average weighted short-term wholesale funding are subject to an LCR requirement of 100% and must disclose liquidity risk data to supervisors on a daily basis. Alternatively, firms with less than $75 billion in average weighted short-term wholesale funding are subject to, at most, an 85% LCR requirement and may generally disclose liquidity risk data to supervisors on a less frequent basis.

placement of unsecured funds by other money market participants. FBO funding profiles remain sensitive to these types of investors as was apparent during the COVID-19 stress period when FBOs experienced buybacks for which they had not sufficiently buffered and investors relied on Federal Reserve facilities, such as the money market mutual fund liquidity facility, to exchange FBO term commercial paper and wholesale certificates of deposit for cash. Compounding this risk is the potential usage of these less stable forms of liquidity for overseas USD risk positions and/or other currency funding not transparent to U.S. regulators. This is not a new risk but one that has been difficult to address.[41]

On the asset side, banks have two primary methods of adjustment: reducing holdings of non-reserve low-yielding investments or increasing holdings of higher-yielding but riskier securities and loans as a proportion of assets, both types of substitution-effect strategies.

- In the first case, banks typically invest a portion of their assets in highly liquid instruments such as reserves and U.S. Treasury securities to satisfy regulatory and internal liquidity risk management requirements and ensure they are capable of meeting their obligations during periods of stress. The most liquid and "cash-like" of these non-reserve assets include U.S. Treasury bills and reverse repo secured by U.S. Treasury securities. As reserves increase, the incentive to hold these other cash-like liquid assets for regulatory and liquidity risk management purposes decreases. To the extent the yields on these assets remain similar or are lower than the interest rate paid on reserves, banks may choose to hold reserves in lieu of these other cash-like substitute investments.
- In the second case, banks may seek to increase the yield on their investment portfolios by holding longer maturity securities or loans (i.e., taking on more interest rate risk and earning a term premium) and investing in less liquid and lower credit-quality assets (i.e., earning liquidity and/or credit premiums).[42] Reaching-for-yield strategies could reduce banks' resilience or reduce capital buffers over time. Indeed banks' capital levels may also be reduced given that a high reserves growth scenario would likely be associated with a downturn in which loan losses were also elevated.

Table 1A summarizes these various optimization strategies and the associated trade-offs.

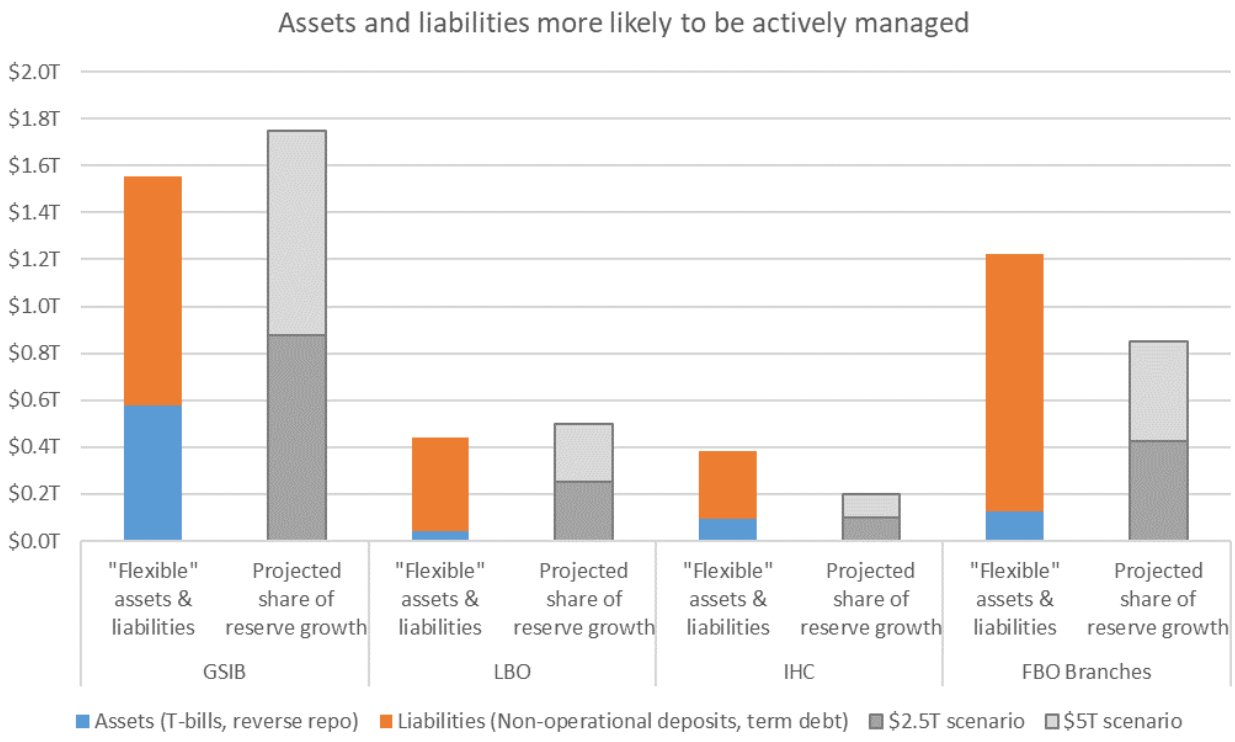
[41] U.S. branches of FBOs face significantly less stringent liquidity regulations in the U.S. and less stringent leverage requirements in their home countries. While FBO branches are regulated, there is no U.S. LCR for them as the rule only applies to FBO intermediate holding companies and their local DIs. FBO branches are only covered by their internal liquidity stress tests which are often less stringent than the US LCR. Firms are covered by their home country regulations, but that does not guarantee their liquidity resiliency by currency or jurisdiction. Transparency remains an issue as maturity or currency transformation risks between offices are difficult to discern.

[42] To avoid potential negative hit to capital from recognizing mark-to-market losses on a relatively riskier investment portfolio, banks may also increasingly classify these securities as "held-to-maturity" for accounting purposes

Optimization capacity and other constraining factors

Figure 1A below illustrates the approximate aggregate balances of banks' assets and liabilities that could be adjusted in response to an increase in the supply of reserves given banks 2020:Q2 balances sheets. This analysis suggests that banks broadly have significant capacity to optimize funding costs and investment portfolio allocations in response to large increases in reserves. However, U.S. GSIBs appear more limited in their capacity to optimize relative to their projected share of reserve growth. This observation does not necessarily suggest that these firms would be unable to absorb increases in reserves, but rather that there is greater uncertainty in how they might adjust their balance sheet in the extreme scenario with $5 trillion of reserves creation. For example, banks may be willing to reduce deposits beyond those included in the figure below to the extent the total revenues earned from a given depositor relationship fall short of covering marginal balance sheet costs.

Figure 1A



Source: FR2052a; H4.1, FRBNY staff calculation.
Note: Flexible assets and liabilities include only USD-denominated obligations; "Reverse repo" includes only maturities within 30 days, secured by Level 1 HQLA; "Debt" excludes structured notes and TLAC/LTD minimum requirements.

Despite the significant apparent capacity for banks to optimize their assets and liabilities to maximize earnings in response to an increase in the supply of reserves, several factors may constrain their ability to do so in practice:

- Interest rate and other earnings risk management limits may place a ceiling on the extent to which banks can extend duration or take on additional credit risk in their investment portfolios.
- Stagnant loan demand may limit opportunities for investment. Similarly, a broad "reach for yield" across market participants could depress returns on higher-risk assets, making them less attractive relative to marginal risk-based capital requirements.
- Banks may be reluctant to fully eliminate certain low-yielding assets given potential franchise implications (e.g., reverse repo client financing). Additionally, banks may retain some higher-cost liabilities to maintain a diverse set of funding sources and preserve relationships with key providers.

There are a number of factors that suggest banks' optimization attempts may be less successful than in past periods of high reserves. The potential for an even greater amount of reserves growth to $5 trillion would further reduce asset yields, while funding costs are already near zero. The incremental flight to liquidity may also be less significant relative to prior period of high reserves since the financial sector was rebounding from a more illiquid state. Additionally, much of the post-crisis regulatory framework had not been fully phased in by 2015, which might have provided greater flexibility for firms to rebalance their assets and liabilities. However, now these regulations are fully phased-in and may further constrain banks' response functions.

Table 1A. Summary of banks optimization strategies associated trade-offs	
Liability optimization strategies	
Push out certain deposits with lower rates, fees or even negative rates.	• Pros: Avoids balance sheet pressure. • Cons: Banks could damage franchise relationship and impair their competiveness or their ability to access these funding sources in the future.
Crowd out other stable funding sources, e.g., FHLBs or other cash providers.	• Pros: Boosts profitability by using funds with lower costs. • Cons: Implies a more vulnerable banking system in the long term. Banks could damage funding relationships that cannot be re-established easily in times of future stress.
Reduce expensive long-term debt at the bank's BHC to boost profitability (although BHC nonbank capital market business would not directly benefit from the growth in deposits and high reserve balance.	• Pros: Reduces funding costs and improves profitability. • Cons: Leaves non-bank entities within a BHC more vulnerable to funding shocks.
Asset optimization strategies	
Reduce lower-yielding HQLAs, such as Treasury bills and reverse repo secured by Treasuries	• Pros: Boosts profitability. • Cons: Banks could damage franchise relationships (e.g., reverse repo client financing).
Shift into higher-yielding assets	• Pros: Boosts profitability. • Cons: Implies a more vulnerable banking system in the long run as banks face higher interest rate and credit risk.
Equity optimization strategies	
Raise tier 1 capital to maintain tier 1 leverage and SLR requirements	• Pros: Increases capital buffers. • Cons: Might be expensive to raise Tier 1 capital.

Appendix C: The Supplementary Financing Program[43]

It was clear, by the middle of the week of September 15, [2008] that the Fed would be providing an unprecedented amount of central bank credit in the course of trying to contain the Global Financial Crisis. Primary dealer borrowings from the Primary Dealer Credit Facility stood at $60 billion, bank borrowings from the Primary Credit Facility had increased by $10 billion, and AIG had borrowed $28 billion. On the Thursday of that week, foreign central banks drew down $64 billion of their new swap lines. Even at that early stage, Federal Reserve credit had expanded by more than $150 billion.

Under the scarce reserves operating regime in place prior to the GFC, when an asset on the Fed's balance sheet expands the Fed offsets, or "sterilizes," the expansion by contracting somewhere else in order to maintain the EFFR at the target specified by the Federal Open Market Committee. For example, the Fed allowed $52 billion of maturing Treasury bills to run off without replacement when it began to auction TAF credit in December 2007.[44] It acted similarly in the spring of 2008 when it expanded the TAF program from $60 billion to $150 billion, introduced the $80 billion single-tranche repo program, and lent $29 billion to Maiden Lane LLC to facilitate the acquisition of Bear Stearns by JPMorgan Chase. To offset that credit expansion the Fed engineered a $236 billion contraction of its Treasury portfolio, running off maturing securities and selling bills and coupon-bearing securities on an outright basis.[45]

In mid-September 2008 the Fed faced an unprecedented problem: it might not be able to sterilize the post-Lehman credit expansion even if it sold all of the Treasury securities that it could sell. By September 17, Federal Reserve holdings of Treasury securities were down to $480 billion. Of that total, $117 billion were on loan to primary dealers through the Term Securities Lending Facility (a facility that, over the course of a four-week cycle, offered to lend up to $200 billion of Treasury securities) and another $50 billion of securities had been set aside for the TSLF Option Program. Thus, at best, the Fed could sell no more than about $230 billion of Treasury securities. If the post-Lehman credit expansion amounted to much more than that, banks would be flooded with reserves and the EFFR would be driven down to zero.

Facing an unprecedented problem, the Fed, in cooperation with the Treasury, came up with an unprecedented solution: the Treasury would sell Treasury bills to the public and deposit the proceeds with the Fed. Sales of bills by the Treasury, and placement of the proceeds of those bills sales at the Fed, was, for purposes of reserve management, functionally equivalent to the Fed selling bills: the public got bills and reserve balances at banks were reduced.

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[43] The material in this appendix is a lightly edited reprint from "Federal Capital and Credit Initiatives Following the Fall of Lehman Brothers" by Kenneth D. Garbade, 2012.

[44] See Garbade and Kambhu (2011, pp. 87-88).

[45] See Garbade and Kambhu (2011, pp. 251-252).

On Wednesday, September 17, the Treasury announced the initiation of "a temporary Supplementary Financing Program ("SFP") at the request of the Federal Reserve."[46] The Treasury stated that "The program will consist of a series of Treasury bills, apart from Treasury's current borrowing program, which will provide cash for use in … Federal Reserve [lending and liquidity] initiatives." As shown in Table 7.7, the Treasury announced, on that day and the following day, six SFP bill sales for a total of $200 billion. Further sales would be arranged as events unfolded in the future.

The novelty of the SFP program led to some confusion in describing the program. The New York Times, for example, reported the first sale of SFP bills by stating, "In a sign of how short the Fed's available reserves had become, the Treasury Department sold tens of billions of dollars of special 'supplementary' Treasury bills on September 17 to provide the Fed with extra cash."[47]

In fact, the Fed did not need any "extra cash." As a central bank of issue and deposit, the Fed can create bank reserves at will by purchasing securities. What the Fed could not fashion from its existing authorities was a way to drain massive quantities of reserves from the banking system. The Wall Street Journal got it mostly right when it stated that the Treasury was "carrying out [a reserve] draining function in place of the Fed."[48] Indeed, the SFP program was a coordinated action between the Treasury and the Fed that boosted the level of balances maintained at the Fed by the Treasury

[46] U.S. Department of the Treasury press release, September 17, 2008. See also Santoro (2012).

[47] "A New Role for the Fed: Investor of Last Resort," New York Times, September 18, 2008, p. A1. See also, "Federal Reserve and Treasury Offer Congress A Plan for a Vast Bailout," New York Times, September 19, 2008, p. A1 ("With the Fed running short of unencumbered reserves, the Treasury Department has begun raising fresh cash for the central bank by selling new Treasury bills … and parking [the proceeds] at the Fed for whatever use it wanted.").

[48] "U.S. Moves to Bolster Fed Balance Sheet," Wall Street Journal, September 18, 2008, p. A3.