Andersen Institute Notes

ANDERSEN INSTITUTE
for Finance & Economics

Ample Reserves, Scarce Financing?: Monetary Policy Implementation in the Age of Fiscal Pressures

James A. Clouse[1]

Highlights

- The Federal Reserve's experience with balance sheet reduction in the 2014-2019 period and in the period from 2022 to 2025 points to possible connections between the asset side of the Fed's balance sheet and demand and supply conditions in repo markets.
- Such connections can arise when banks face limits on their ability to arbitrage across markets.
- When arbitrage is constrained, increases in longer-term federal debt outstanding may put upward pressure on repo rates.
- Effective monetary policy implementation in this case may require adjustments on the asset side of the Fed's balance sheet even when reserves are ample.
- Fiscal pressures and the associated potential for binding arbitrage constraints could affect many aspects of Fed balance sheet policy and monetary policy implementation over coming years.

---

[1] James Clouse is a senior fellow at the Andersen Institute. This note has benefitted from helpful comments and suggestions from colleagues including Fabio Natalucci, Charles Calomiris, and Brian Boeckman and from a remarkable "referee report" on an earlier draft obtained through the AI tool Refine.

Introduction

"The Committee judges that reserve balances have declined to ample levels and will initiate purchases of shorter-term Treasury securities as needed to maintain an ample supply of reserves on an ongoing basis."

December 2025, FOMC Statement

With that single low-key sentence in its December statement, the FOMC marked another major milestone in the evolution of the Federal Reserve's balance sheet. Barring major changes to the Fed's approach to monetary policy implementation, the size of the Fed's balance sheet has now reached a "new normal." Reserves currently stand at about $3 trillion and would be expected to expand gradually over time from this point onward to remain consistent with ample reserves conditions, perhaps following a trajectory roughly in line with nominal GDP.[2]

For those who can remember policy implementation in the decades prior to the Global Financial Crisis (GFC), the rather brisk increase in the federal funds rate and other short-term interest rates last September with reserve levels in the neighborhood of $3 trillion is quite remarkable and strongly suggests fundamental changes in reserve demand over time. Indeed, many observers have pointed to liquidity regulations and liquidity supervision as key factors contributing to higher reserve demand. Others have noted the scars left by extreme liquidity strains during the GFC and the pandemic and a resulting much higher demand for "safe assets." Still others have noted that large scale asset purchases may have indirectly contributed to reserve demand by boosting runnable deposits in the banking system.[3]

While the apparent fundamental changes in the nature of reserve demand over recent years have understandably garnered a great deal of attention, the two periods of Fed balance sheet normalization—2014-2019 and 2022 to present—provide some hints about additional factors that could be at play. Both periods were characterized by declining reserve levels and periods of heavy Treasury debt issuance. And in both periods, money market pressures were evident in bank funding markets and in Treasury repo markets. As discussed in more detail below, repo market pressures became particularly acute in the fall of 2019. The upward pressure on repo rates during these transition periods is notable and not easy to explain solely in terms of reserve demand and supply. This observation leads naturally to questions about the possible broader connections between the Fed's balance sheet and demand and supply conditions in repo markets.

---

[2] Of course, Kevin Warsh, the President's nominee to become Chair of the Federal Reserve Board, has commented publicly about the potential to substantially reduce the size of the Federal Reserve's balance sheet. Significantly reducing the size of the Federal Reserve's balance sheet would almost certainly require a move away from the existing ample reserves regime for monetary policy implementation.

[3] See, for example, September 2025 Senior Financial Officer Survey Results and Acharya, Chahaun, Rajan, and Steffen (2024) Liquidity Dependence and the Waxing and Waning of Central Bank Balance Sheets.

The discussion below explores the possible connections between the Treasury repo market and the asset side of the Fed's balance sheet in the context of a simple model of money markets. To give the punch line upfront, the analysis suggests that in scenarios in which banks are limited in their ability to arbitrage across markets, both sides of the Fed's balance sheet can be important for effective monetary policy implementation. A key factor that can give rise to such scenarios is the pressure from heavy long-term Treasury debt issuance interacting with dealer balance sheet constraints and impediments to arbitrage for banks.

The remainder of this note proceeds as follows. Section 1 provides some additional detail on the two periods of Fed balance sheet normalization. Section 2 describes a simple analytical framework that may be helpful in tracing linkages between the Fed's balance sheet and money market developments. Section 3 discusses some possible policy implications of this framework and section 4 concludes.

1. Background

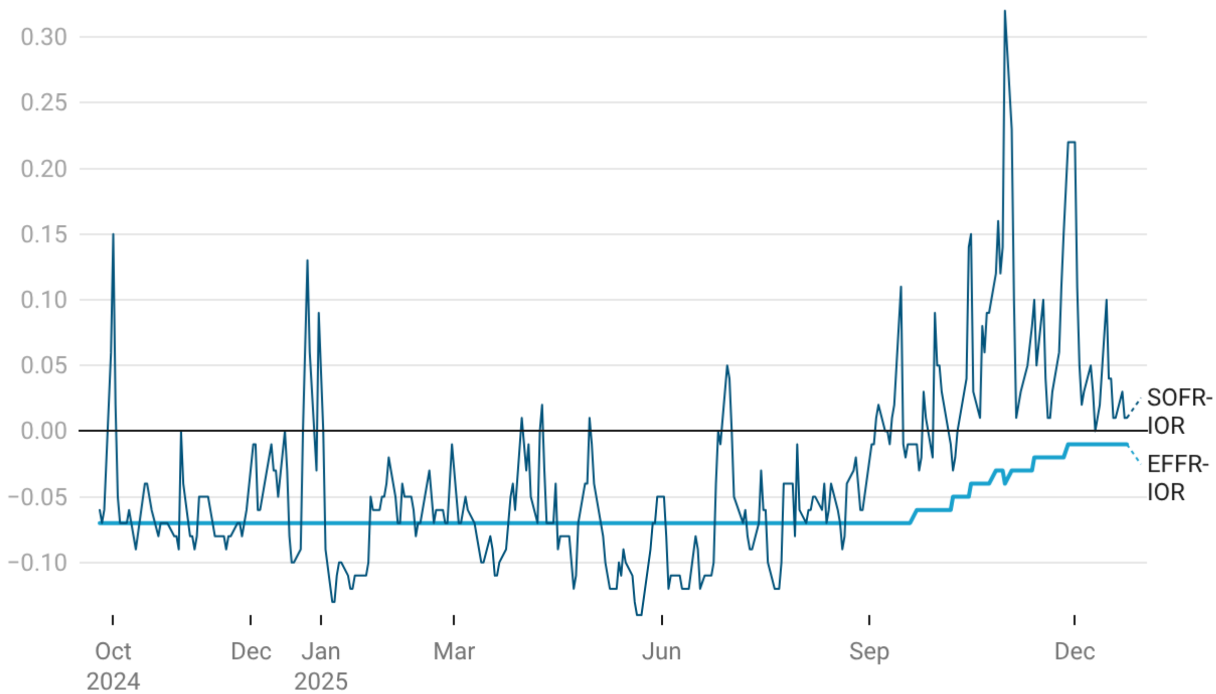
In 2022, the FOMC published two important statements related to balance sheet normalization—the Principles for Reducing the Size of the Balance Sheet (Principles) and the Plans for Reducing the Size of the Balance Sheet (Plans). In the Principles statement, the Committee noted that it viewed changes in the effective federal funds rate to be its primary tool for adjusting the stance of monetary policy. In addition, it noted that over time, it intended to hold securities in the amounts needed to implement monetary policy efficiently and effectively in its ample reserve regime. In its Plans statement, the FOMC outlined a gradual process of reducing the size of the balance sheet through the passive runoff of maturing securities. The Committee noted that it would slow and then stop balance sheet runoff at a point with reserves still somewhat above ample levels. Once reserves reached an ample level, the FOMC would manage securities holdings to maintain ample reserve conditions over time. An underlying theme of the Plans was to keep the gradual balance sheet reduction process in the background and away from the headlines. Some policymakers suggested that the process should ideally be "as dull as watching paint dry."

The Balance Sheet Reduction Endgame

For more than three years, the Fed's balance sheet reduction process proceeded smoothly and largely as envisioned in the Plans document. Month after month, the Fed allowed a portion of its maturing securities to run off without replacement. That gradual process had slowly trimmed the size of the Fed's balance sheet from a peak of about $9 trillion to about $6.6 trillion last September. Throughout this period, markets took the balance sheet reduction process in stride. The federal funds rate held remarkably steady throughout the process and volatility in repo markets as reflected in the secured overnight financing rate (SOFR) was modest. In line with its plans for reducing the size of the balance sheet, the FOMC slowed the pace of balance sheet runoff over time to $40 billion per month as of last spring. Against this backdrop, as of August of last year, many observers (present company included) anticipated that the balance sheet reduction process could continue for quite some time yet.

But money markets have a way of surprising. Toward the end of September, upward pressures in the federal funds market became apparent. After years with the effective federal funds rate (EFFR) pegged firmly at 7 basis points below the interest rate on reserve balances (IORB), the funds rate moved up 6 basis points relative to the IORB rate in the space of six weeks and repo rates moved higher as well (chart 1). In response to these developments, the final stages of the Fed's slow, gradual, "dull as watching paint dry" balance sheet reduction process suddenly shifted into high gear.

Chart 1: Balance Sheet Reduction: 2024-2025



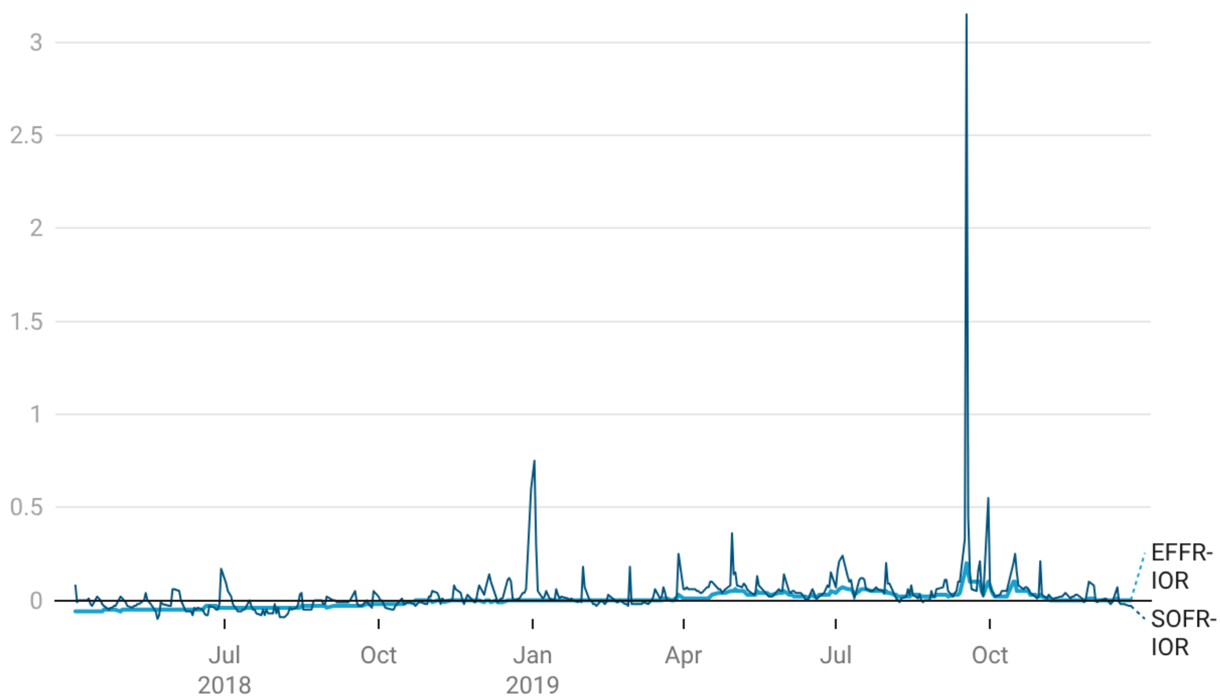
Vertical axis in percentage points. Tick marks at the beginning of each month.
Created with Datawrapper

At its October meeting, the FOMC judged that it was nearing an "ample" level of reserves and announced that it would cease balance sheet runoff beginning in December. And at its December meeting, the FOMC concluded that it was appropriate to begin "reserve management purchases" of Treasury bills in order to maintain ample reserve conditions over coming months and, in particular, to smooth through the variations in reserves anticipated over the April 2026 tax season.

Balance Sheet Reduction: The Ghost of 2014-2019

Throughout the entire process of balance sheet reduction from June 2022 to present, the Fed's earlier experience with balance sheet reduction in the 2014-2019 period was the "ghost of balance sheet reduction past," haunting the minds of market analysts, economists and policymakers. In that earlier period, the Fed had followed a gradual process of reducing the size of the balance sheet over several years. Over the course of 2018, the federal funds rate began to edge up relative to IORB and, by early 2019, had moved a little above IORB. The pressures in the federal funds market were accompanied by a fair bit of volatility in the repo market as well, particularly on month ends and Treasury auction settlement dates. Then, in September of 2019, amid a confluence of market factors, these pressures came to a head, resulting in a brief but intense period of strain in repo markets that spilled over to the federal funds rate (chart 2).[4]

Chart 2: Balance Sheet Reduction (2018-2019)



Vertical axis in percentage points. Tick marks at the beginning of months.

Created with Datawrapper

The culprits behind the September 2019 repo market meltdown remain a little mysterious but the prime suspects include a sharp decline in reserves associated with corporate tax payments, large settlements for Treasury auctions, possible disruptions in the availability of repo financing associated with outflows from money market mutual funds, constraints on dealer intermediation capacity amid heavy Treasury debt issuance, and various impediments to arbitrage that left some investors content or constrained to sit on the

[4] See Anbil, Andersen, and Senyuz (2020) What Happened in Money Markets in September 2019? and Copeland, Duffie, and Yang (2024) Reserves Were Not So Ample After All for detailed discussions of this episode.

sidelines despite very elevated repo rates. In the event, the FOMC reacted quickly by providing additional repo financing with open market operations and by initiating purchases of Treasury bills to boost reserves to levels prevailing in early September. By the end of October, money market conditions had largely returned to normal.

The FOMC learned a great deal from this painful experience and was carefully monitoring money market conditions throughout 2025 for any indications of a buildup of market pressures similar to those over the period 2018-2019.[5] As noted above, when money markets started to tighten last fall, the FOMC wisely did not wait around to see how much additional balance sheet reduction could be eked out with a few more months of balance sheet runoff. The FOMC ceased balance sheet runoff with the spread of the funds rate to IORB at about the same level prevailing in late 2018.

2. An Illustrative Model

While developments in repo markets have been the center of much attention in money markets over recent years, workhorse models of monetary policy implementation tend to focus almost exclusively on simple reserve demand and supply relationships with the repo market generally nowhere to be found. The discussion below attempts to integrate the repo market more fully into a standard model of monetary policy implementation based on a simple analytical framework that is helpful in tracing linkages across markets and financial institutions.[6] Technical details are left to the appendix, but the key ingredients in the model are factors that limit arbitrage across markets. Households, for example, are assumed to treat financial assets including bank deposits, long-term Treasury debt, and lending in repo markets as imperfect substitutes. Dealers act as key intermediaries in Treasury markets, investing in long-term Treasury debt with repo financing from banks and households. Dealer balance sheets, however, are constrained by balance sheet costs associated with maintaining inventories of longer-term Treasury securities.[7] Banks have ready access to deposits but face costs if reserves fall “too low” or if lending in repo markets moves “too high.” When aggregate reserves fall below a threshold, reserves become scarce and that puts upward pressure on short-term rates including repo rates, Treasury bill rates, and deposit rates. And if bank repo lending moves “too high,” banks begin to experience some costs that lead them to require higher repo rates to provide additional repo market lending.[8]

---

[5] See Perli (2024) for a discussion of Federal Reserve market monitoring. Balance Sheet Normalization: Monitoring Reserve Conditions and Understanding Repo Market Pressures.

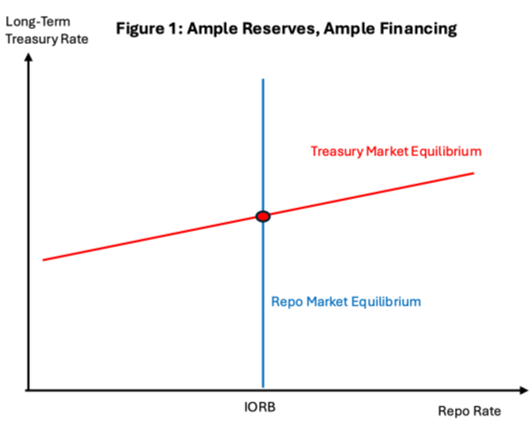
[6] See Chen, Clouse, Ihrig, Klee (2016) The Federal Reserve's Policy Normalization Tools in a Preferred Habitat Model of Financial Markets and Clouse (2024) A Field Guide to Monetary Policy Implementation Issues in a New World with CBDC, Stablecoin, and Narrow Banks for discussion of the basic framework used here. See Anbil, Andersen, Ruprecht and Cohen (2024) Stop Believing in Reserves for a related discussion of many of the issues raised in this note in a more sophisticated model.

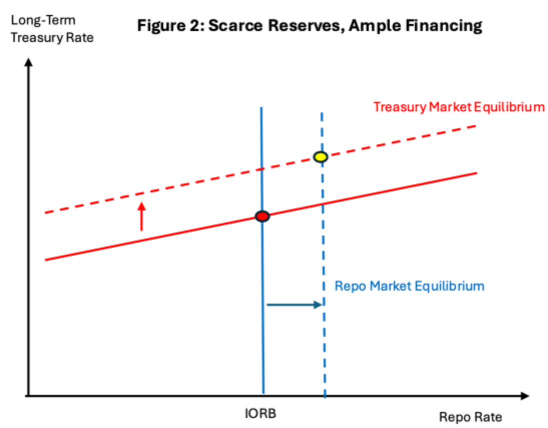
[7] Balance sheet costs are assumed to be a function of inventories of long-term Treasury securities because they expose dealers to interest rate risk that must be managed. See Duffie, Fleming, Keane, Nelson, Shachar, Van Tassel (2023) Dealer Intermediation Capacity and U.S. Treasury Market Functionality for a detailed discussion of dealer balance sheet costs and dealer intermediation capacity.

[8] Survey evidence suggests that many banks do require a spread of repo rates over IORB to induce lending in repo markets. See, for example, question 12 in the Federal Reserve’s Senior Financial Officer Survey Senior Financial Officer Survey.

Most of the key features of the framework can be gleaned from simple diagrams like that shown in figure 1. The solid red line in this picture represents all the combinations of long-term Treasury rates and repo rates that are consistent with equilibrium in the Treasury market. The blue line represents the combinations of Treasury rates and repo rates that are consistent with equilibrium in the repo market. When banks are unconstrained by costs associated with lending in repo markets, they will arbitrage perfectly between holdings of reserves and lending in repo markets. As a result, the repo market equilibrium line is vertical with the repo rate pegged at IORB. Banks also arbitrage perfectly in deposit markets so the deposit rate is also pegged at IORB.

Figure 2 shows what happens when reserves become scarce. In this case, the value of an additional dollar of reserves encompasses both the explicit rate of interest on reserves and a marginal value of liquidity. Banks then require that same effective rate of return for any lending in repo markets or in holding Treasury bills, moving the repo market equilibrium line to the right. The Treasury market equilibrium shifts up because the higher effective return on reserves and other short-term instruments requires a higher longer-term Treasury yield to maintain the same level of demand for longer-term Treasury securities. The equilibrium long-term Treasury rate and repo rate move up from the red dot to the yellow dot. In this case, the deposit rate moves up as well and remains aligned with the higher repo rate.





Figures 3 and 4 illustrate the effects of bank repo costs and fiscal pressures while reserves remain ample. In figure 3, once banks begin to experience costs in repo lending, the repo market equilibrium line shifts from vertical to upward sloping. The change stems from the fact that banks now require more inducement in the form of higher repo rates to expand their lending in repo markets. Figure 4 shows the same diagram with the effects of an increasing quantity of long-term Treasury debt outstanding. When banks are still unconstrained by repo costs, an increase in long-term Treasury debt outstanding shifts the Treasury market equilibrium curve up and the Treasury rate is determined on the vertical portion of the repo market equilibrium line. That will be the case up to the point at which the equilibrium Treasury rate reaches the green dot. Beyond that threshold point, increased fiscal pressures push both longer-term Treasury rates and repo rates up along the repo market equilibrium line (from the green dot to the yellow dot). When reserves remain ample, the deposit rate and Treasury bill rate remain pegged at IORB.

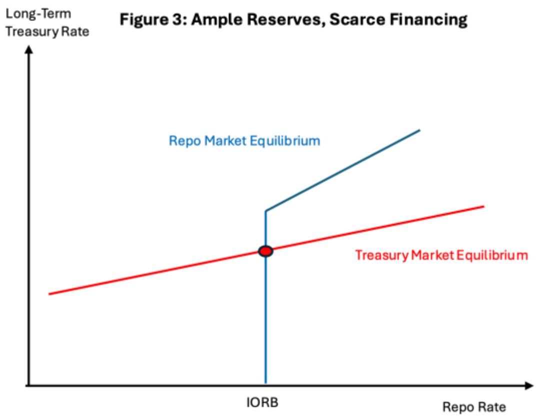


Figure 3: Ample Reserves, Scarce Financing

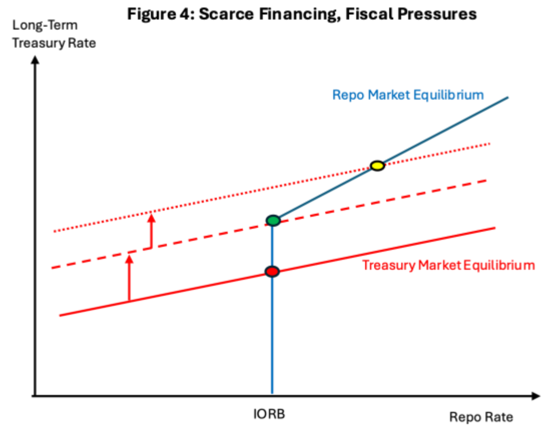


Figure 4: Scarce Financing, Fiscal Pressures

Figure 5 illustrates the effect of an increase in bank marginal costs of lending in repo markets. The repo market equilibrium in this case flattens and the equilibrium Treasury rate and repo rate move up from the yellow dot to the green dot. Again, these effects may occur even when reserves are ample and with other short-term rates still aligned with IORB. Figure 6 illustrates the effect of an increase in reserve scarcity when financing is scarce as well. The Treasury market equilibrium line shifts as in figure 4 from the solid red line to the dashed red line reflecting the pressure from an assumed increased supply of longer-term Treasury securities. That shift initially pushes repo rates and long-term Treasury rates higher, moving from the red dot to the yellow dot. The introduction of reserve scarcity pushes the repo market equilibrium curve to the right and the Treasury market equilibrium line a little higher to the dotted red line. The long-term Treasury yield and repo rate move higher from the yellow dot to the green dot.

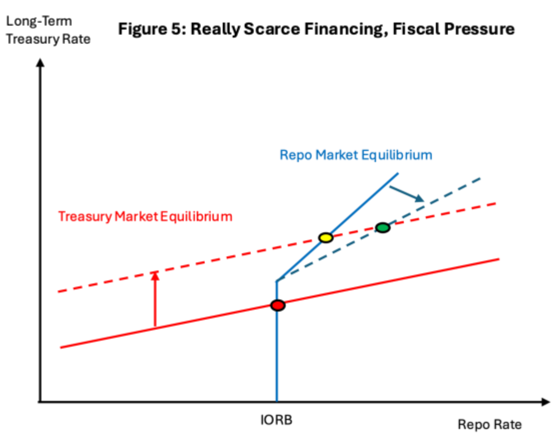


Figure 5: Really Scarce Financing, Fiscal Pressure

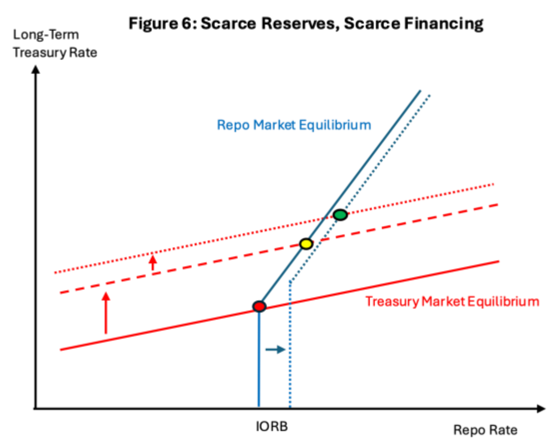


Figure 6: Scarce Reserves, Scarce Financing

Figure 7 illustrates the effect of a Fed standing repo facility (SRF) with the SRF rate set just a little above the IORB rate. In the face of fiscal pressures, once the market repo rate reaches the SRF rate, the Fed satisfies dealer demand for repo financing at the SRF rate. The effective repo market equilibrium line becomes vertical at the SRF. Relative to the equilibrium in the scenario without the SRF, shown by the green dot, the long-term Treasury rate and repo rate decline moving from the green dot to the yellow dot. The reduction in the equilibrium repo rate in this case coincides with an increase in bank reserves but, assuming reserves were already ample to begin with, the increase in reserves is not a factor putting downward pressure on repo rates.

Figure 7: Standing Repo Operations

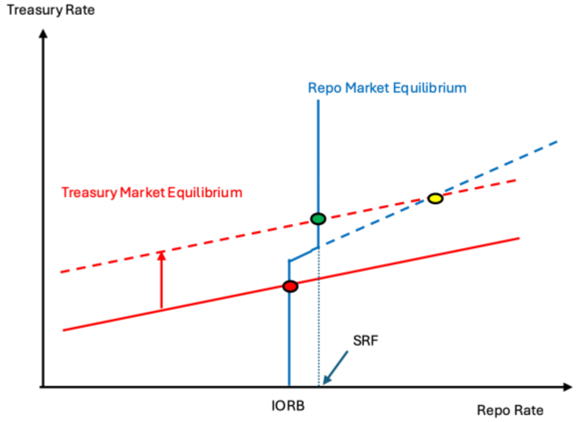


Figure 8: Scarce Financing, Fiscal Pressure, Fed Balance Sheet Expansion

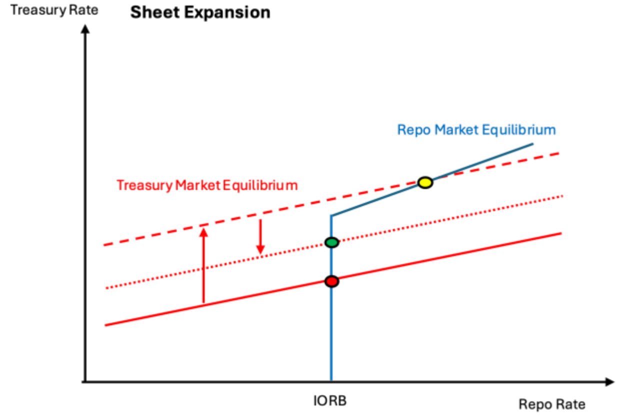


Figure 8 depicts an alternative approach the Fed could take in addressing the effects of fiscal pressures on repo rates. In this diagram, the Fed expands its holdings of longer-term securities resulting in a downward shift of the Treasury market equilibrium line (from the dashed red to the dotted red line). The equilibrium long-term Treasury rate and repo rate then fall, moving from the yellow dot to the green dot.

3. Possible Policy Implications

The model described above is helpful in studying various aspects of Fed balance sheet actions—it captures a connection between Fed purchases of long-term securities and long-term Treasury yields, nests a standard textbook model of reserve demand, and highlights one possible additional channel of Fed influence in money markets running from the asset side of the Fed's balance sheet to outcomes in the repo market. That said, as with any model, it captures only a small portion of the very complex structure of money markets and monetary policy implementation. The key results in the model rely on very strong assumptions about investor behavior and the costs that households, banks and dealers may face in arbitraging across markets. Moreover, the model is heavily focused on the behavior of banks and does not take account of many other important types of institutions that are active participants in repo markets such as hedge funds, money funds, asset managers, and corporations.

With the foregoing as caveat emptor, it may nonetheless be useful to consider some of the policy implications that follow from the key mechanisms in the model. To this end, the discussion below highlights the model implications for interest rate configurations, balance sheet reduction, the "normal" size of the Fed's balance sheet, possible transitions to alternative operating frameworks, the composition of the balance sheet, possible liquidity facilities to address pressures in repo markets, and issues in connection with alternative interest rate targets.

Interest Rate Configurations

One of the stronger implications of the model is that changes in bank marginal funding costs relative to IORB reflect changes in the marginal liquidity value of reserves. As a result, one might look to measures like the spread of the effective federal funds rate or the overnight bank funding rate relative to IORB as a gauge of the marginal liquidity value or "ampleness" of reserves. A related implication is that a rate configuration with the level of EFFR appreciably above IORB is a telltale sign of significant reserve scarcity. In the absence of reserve scarcity, banks in the model would never pay a rate above IORB on deposit funding because they could always fund additional assets more cheaply by running off reserves. With the clarity of hindsight, the move of the EFFR appreciably above IORB in early 2019 was a clear sign of growing reserve scarcity.

Another implication of the model is that reserve scarcity affects all money market rates in the same way and by the same amount. As a result, changes in reserve scarcity leave the spread between the repo rate and bank marginal funding costs (EFFR) unaffected. In contrast, the spread of the repo rate over the EFFR widens at times when constraints on banks' repo market arbitrage come into play.

The table below reviews the two balance sheet adjustment episodes with these considerations in mind. The EFFR-IORB spread is taken as a measure of the scarcity of reserves. And the spread of SOFR over EFFR is taken as a measure of arbitrage constraints in repo markets. The first two columns of the table show monthly averages of these spreads in 2019 and the last two columns show the same spreads for the corresponding months in 2025.

As shown in the first row of the table, by March of 2019 the EFFR had already moved up to the level of IORB. As noted above, the model suggests that configuration of rates signaled a degree of significant reserve scarcity. Moreover, over subsequent months, variations in the EFFR-IORB spread seemed to be loosely positively correlated with the SOFR-EFFR spread. That behavior might suggest that money markets had moved into the regime with both reserve scarcity and arbitrage constraints at play as shown in figure 6 above. A positive correlation between the two spreads could stem from the combined effects of developments on both sides of the Fed's balance sheet. The runoff of Fed securities holdings and corresponding increases of private sector holdings of longer-term securities would be a factor putting upward pressure on the SOFR-EFFR spread while the corresponding decline in reserves and increase in reserve scarcity put upward pressure on the EFFR-IORB spread.[9] In this interpretation, the large jump in the SOFR-EFFR spread in September of that year would be a sign of intensifying repo market arbitrage constraints exacerbated by an increase in reserve scarcity.

The situation in 2025 was quite different. In March of last year, the EFFR was 7 basis points below IORB, suggesting an ample supply of reserves. Moreover, the SOFR-EFFR spread was fairly stable from March through August, suggesting that arbitrage constraints were not yet in play. In September however, the

[9] Here we assume that the Treasury issues additional long-term securities to meet the funding need arising from the runoff of the Fed's securities holdings. In contrast, in the model, the SOFR-EFFR spread would be unaffected if the Treasury met this funding need entirely with new issuance of Treasury bills.

SOFR-EFFR spread widened substantially while the EFFR-IORB spread edged only slightly higher, on average. In terms of the model, that development is analogous to the scenario shown in figure 4 in which fiscal pressures push the system into the scarce financing regime while reserves remain ample. In October though, the increase in the EFFR-IORB spread would be interpreted as a sign of increasing reserve scarcity that would push both the EFFR and SOFR rates higher.

Of course, this sort of casual empiricism is only suggestive and certainly does not establish that the mechanisms in the model were the key factors driving changes in money market rates during these episodes. To delve into these matters further, it would be quite useful to look at the repo market behavior of banks to ascertain whether their lending in repo markets—both quantities and rates--during these periods actually aligns with the optimizing behavior for banks suggested by the model.

Liquidity and Financing Pressures: 2019 and 2025

Month	EFFR-IORB (2019)	SOFR-EFFR (2019)	EFFR-IORB (2025)	SOFR-EFFR (2025)
Mar	0.004	0.013	−0.070	−0.003
Apr	0.022	0.054	−0.070	0.019
May	0.040	0.028	−0.070	−0.025
Jun	0.025	0.018	−0.070	−0.013
Jul	0.053	0.047	−0.070	0.007
Aug	0.025	0.003	−0.070	0.014
Sep	0.072	0.219	−0.067	0.073
Oct	0.041	0.034	−0.045	0.119
Nov	0.003	0.020	−0.023	0.101
Dec	0.001	−0.005	−0.010	0.069

Spreads in percentage points. Source: Federal Reserve Economic Database (FRED), Federal Reserve Bank of St. Louis.

Created with Datawrapper

Balance Sheet Reduction Paths

The framework described above suggests that, absent any limits on arbitrage in repo markets, the transition from abundant to ample reserves really should be as dull as watching paint dry. Beginning from a point of abundant reserves, securities rolling off the Fed's balance sheet would be accompanied by a slow decline in reserves. Assuming that the Treasury meets part of the resulting funding need by issuing longer-term securities, there would be some resulting modest upward pressure on longer-term Treasury yields. However, with banks arbitraging actively across markets, the repo rate, deposit rate and Treasury bill rate would all be pegged at the IORB. Once reserves declined to a point at which liquidity costs begin to take hold, there would be some gentle upward pressure on money market rates corresponding to a steady march up the reserve demand curve. The Fed could easily address these pressures by ceasing balance sheet runoff and purchasing Treasury bills to maintain ample reserves.

Unfortunately, real world financial markets apparently did not get the memo explaining just how simple the balance sheet adjustment process is supposed to be. In 2025 and especially in 2019, the balance sheet process proved to be rockier than one would expect from a hypothetical gradual march up a stable reserve demand curve. In both episodes, short-term interest rate adjustments occurred abruptly after balance sheet reduction had been underway for some time.

In the model developed above, the possibility of binding constraints on arbitrage in repo markets could be one factor tending to make the balance sheet adjustment process a bit more “exciting” than policymakers might hope. Starting from a point of abundant reserves and no arbitrage constraints in repo markets, securities rolling off the Federal Reserve’s balance sheet would again put upward pressure on Treasury yields. That upward drift in long-term Treasury yields could be compounded if the Treasury is simultaneously issuing large quantities of longer-term debt to finance its operations. In this case, it’s possible that the increased financing needs of dealers could begin to push banks to the point at which their lending in repo markets entails some costs. As shown in figures 4 and 5, depending on the nature of these costs, the repo rate could move up quite abruptly even when reserves are well above ample levels.[10]

The upshot is that in a world with arbitrage constraints in repo markets, it’s possible that the repo rate could become disconnected from other money market rates during a process of balance sheet reduction. The potential for this type of market disconnect is greater when the fiscal backdrop is also a source of pressure on dealer financing. These types of potential market pressures in the Treasury cash and repo market underscore the range of possible risks present during periods of Fed balance sheet reduction.

The Normal Size of the Balance Sheet with Ample Reserves

In the absence of potential costs faced by banks in lending in repo markets, the implications of the model for the size of the balance sheet would be quite standard.[11] To effectively implement an ample reserves regime, the Fed would only need to manage the quantity of reserves in the banking system to remain above the threshold level of reserves at which scarcity effects take hold. With due allowances for shocks to the supply and demand for reserves, policymakers might choose to maintain a “buffer” somewhat above this

---

10 . Note that the net return for banks in repo lending (the repo rate less the marginal cost of lending) would remain aligned with IORB. As a result, other money market rates including the federal funds rate would remain pegged at the IORB.

11 For recent discussions of various aspects of the standard model of reserve demand, see Ihrig, Meade, Weinbach (2015) Rewriting Monetary Policy 101: What's the Fed's Preferred Post-Crisis Approach to Raising Interest Rates?, Lopez-Salido and Vissing-Jorgenson (2023) Reserve Demand, Interest Rate Control, and Quantitative Tightening, Afonso, La Spada, Mertens, Willaims (2023), The Optimal Supply of Central Bank Reserves under Uncertainty, and Clouse, Infante, and Senyuz (2025) Market-Based Indicators on the Road to Ample Reserves.

threshold level of reserves. And while the threshold level of reserves might be difficult to measure, the Fed could look to the level of short-term interest rates relative to the IORB rate to gauge whether scarcity effects were starting to emerge. That general view seemed to inform much of the FOMC's approach to reducing the size of the balance sheet described above.

The potential for banks to experience costs in lending in repo markets above a threshold level adds another layer of complexity to the Fed's balance sheet management. As noted above, in an environment with heavy issuance of longer-term Treasury debt, pressure on dealers to finance growing inventories of securities puts upward pressure on repo rates even with ample reserves. Similar to the scenario depicted in figure 7, if the Fed wished to maintain repo rates close to the level of other short-term interest rates, it could rely on standing repo operations to address the effects of fiscal pressures on repo rates. Alternatively, as shown in figure 8, the Fed could address those pressures by expanding its holdings of longer-term Treasury securities. In either case, the size of the Fed's balance sheet would be larger than necessary to maintain ample reserves.

Alternative Operating Regimes: Back to the Future?

These observations also bear on the issue of a possible transition from the ample reserves regime to a scarce reserves regime. Many observers have pointed to possible benefits of returning to a scarce reserves regime including a much smaller Fed balance sheet, a smaller "footprint" of the Federal Reserve in financial markets, and less exposure of the Federal Reserve to the risk of financial losses and associated political pressures.

Of course, a move away from the Fed's ample reserve regime would be an enormous and risky undertaking in practice.[12] But in the orderly world of models, absent repo market constraints, the transition would be quite straightforward in theory. The Fed would simply allow its securities holdings to continue to gradually run off. As the resulting reserve scarcity showed through to the level of short-term interest rates, the Fed would also gradually reduce IORB to keep short-term rates at the desired level. In the presence of repo market constraints, however, the reduction of the size of the Fed's holdings of longer-term Treasury securities could put significant upward pressure on long-term Treasury rates and repo rates. In this scenario, moving from ample to scarce reserves would not be all about managing reserve levels. The asset side of the Fed's balance sheet could become a very important factor influencing financial market outcomes.

Composition of the Balance Sheet

Similar considerations might become relevant over time in the Fed's approach to the maturity composition of the balance sheet. At present, the weighted average maturity of the Fed's Treasury holdings is close to 9 years while the weighted average maturity of the public's holdings of Treasury securities is close to 6 years. Assuming the Treasury maintains a weighted average maturity of new issuance at about 6 years, a decline in the maturity composition of the Fed's portfolio will imply an upward drift in the weighted average maturity of debt held by the non-Fed public. In the model, that trend would tend to put upward pressure on

[12] A key risk factor is that almost nothing is known about the nature of the reserve demand curve now with reserves at low levels. In contrast, prior to the GFC, a complicated system of reserve requirements was the key structural factor shaping bank demand for reserves.

longer-term Treasury yields and could lead to arbitrage constraints that push repo rates higher as well. Similar to the diagram in figure 8, the Fed could damp some of these pressures by tilting the composition of its portfolio toward longer-term securities. In addition, as noted below, the Fed could develop or enhance facilities to provide repo financing.

Liquidity Facilities

Similar to the scenario depicted in figure 7, another approach the Fed might take in responding to pressures in the repo market might be to step in to provide repo financing when necessary to fill the gap between dealer demand for repo financing and the supply of repo financing available from households and banks. In the model, a standing repo facility that dealers could turn to when the spread of repo rates over the IORB rate reached a predetermined level would be quite effective in damping repo market pressures and the associated upward pressures on longer-term Treasury yields. Of course, the Fed established just such a Standing Repo Facility in 2021 to support effective policy implementation and "smooth market functioning."

As shown in figure 7, in the event of fiscal pressures on repo rates, an active Fed repo facility could keep longer-term Treasury yields and repo rates substantially lower than would otherwise be the case. However, from the perspective of the model, a perfectly functioning repo facility would not eliminate the upward pressures on the size of the Fed's balance sheet. Additional assets acquired to damp repo market pressures would just be in the form of ongoing repo lending rather than additional outright holdings of longer-term Treasury securities.

Of course, a variety of practical issues arise in providing a standing facility of this type. Dealers must be willing to turn to the facility when financing markets tighten. For that to be the case, use of the facility must be stigma-free—that is, dealers utilizing the facility must believe that there will be no adverse market or supervisory consequences for utilizing the facility. In addition, other potential costs of turning to the facility should be minimal. For example, the FOMC has discussed the possibility of establishing arrangements that would allow dealers to net repo borrowing from the Fed and thereby avoid the potential capital costs associated with borrowing in standing repo operations at present.[13] Finally, the facility would need to be available to a broad enough range of borrowers in repo markets to be able to effectively address market-wide pressures.[14]

As noted above in the discussion of Figure 8, temporary purchases of longer-term Treasury securities could achieve many of the same objectives as standing repo operations. Such purchases relieve dealer balance sheet pressures and result in both lower Treasury yields and lower repo rates. Note that the effect of a temporary outright purchase of a longer-term Treasury security differs from a temporary repo operation. A temporary purchase removes duration risk from dealer balance sheets and directly affects their balance

[13] One approach that has been discussed along these lines would be for the Fed to become a member of the Fixed Income Clearing Corporation (FICC). In that case, dealers borrowing from the Fed in repo operations could net that borrowing against repo lending to other FICC members. For a recent discussion of this possibility, see the minutes of the October FOMC meeting at [Monetary Policy: Minutes](#).

[14] Only primary dealers and banks are eligible to participate in the Fed's standing repo operations. Addressing liquidity needs for other participants in the repo market through standing repo operations then requires Fed counterparties to borrow from the Fed and lend to other entities in need of financing.

sheet costs. A temporary repo operation provides liquidity assistance to dealers but does not reduce duration risk or balance sheet costs in the same way.

It is worth noting that, again from the narrow perspective of the model, there is nothing special about a Fed repo market liquidity facility. The Treasury could provide such a facility as well and finance any lending with issuance of Treasury bills.[15] In this case, banks would end up holding the additional Treasury bills issued by the Treasury and would finance those holdings with additional deposit funding.

A Treasury provided liquidity facility would be subject to the same practical issues noted above for a Fed facility and one more very important one—the federal debt ceiling. Absent legislation that redefined debt subject to the limit to exclude debt issued for the purpose of repo lending, the debt ceiling could act as a limit on the ability of a Treasury liquidity facility to address repo market strains. Indeed, one could well imagine that market concerns about a debt ceiling episode might spur repo market strains. In that case, the associated constraints on lending capacity of a Treasury repo facility could bind at a very inopportune time.

Interest Rate Targets

The model discussed above also bears on the question of interest rate targets for the Fed. In the regime in which bank liquidity costs and repo lending costs are not active, there is no real difference in choosing to target a deposit rate, or the Treasury bill rate, or the Treasury repo rate.[16] (In the model, the "deposit rate" encompasses the current federal funds rate.) As discussed above, all of these rates would be pegged at the interest rate on reserve balances. Indeed, even in the world in which banks face liquidity costs associated with scarce reserves, there is no real difference in targeting one rate versus another—they all would be equal to the interest rate on reserve balances plus the marginal liquidity value of reserves.

In the regime in which repo lending costs come into play, however, there are meaningful differences between targeting repo rates versus other short-term interest rates. In this regime, repo rates are pushed above the level of other short-term interest rates and influenced by fiscal pressures. As noted above, to address these pressures, the Fed could purchase longer-term securities or provide repo financing to dealers. In short, at least from the standpoint of the model, maintaining repo rates at a specified target would require the Fed to be responsive to changes in Treasury financing needs and the availability of repo financing provided by private sector sources.

4. Conclusion

As discussed in an earlier Andersen Institute note, even apart from full-fledged fiscal dominance, fiscal pressures potentially pose a range of important practical issues for the Fed over time.[17] This note

[15] The Treasury already is actively involved in steps to support Treasury market liquidity through its weekly liquidity support buyback program. Quarterly Refunding Statement of Assistant Secretary for Financial Markets Josh Frost.
[16] See Logan and Schulhofer-Wohl (2025) Options for modernizing the FOMC's operating target interest rate for a discussion of the rationale for moving to a repo rate targeting regime.
[17] See Clouse and Kurtenbach (2025) Federal Reserve Independence, Federal Finance, and the Uneasy Relationship.

elaborates on some of the implications that fiscal pressures might pose for the Fed's implementation of monetary policy and the evolution of its balance sheet. Not surprisingly, when there are significant limits on dealer intermediation capacity and constraints on the extent to which banks and other investors can arbitrage across markets, the Fed's ability to tightly control a range of short-term interest rates may be diminished. Given the U.S. fiscal outlook with primary deficits running at 2 percent of GDP and debt held by the public rising to 120 percent of GDP over the next 10 years, it seems likely that the interplay between dealer intermediation capacity, arbitrage constraints, and monetary policy implementation will remain an important theme over coming years.[18]

[18] For more details on the current fiscal outlook, see The Budget and Economic Outlook: 2026 to 2036 | Congressional Budget Office

Analytical Framework

The model is similar in structure to Chen et. al. (2014), Clouse (2024), and Brainard and Tobin (1969).[19] Households allocate a fixed endowment of wealth across three financial assets—long-term Treasury debt, repurchase agreements (repos) with dealers, and bank deposits. Banks take in household deposits and also tap additional foreign deposits freely at the market deposit rate. The Treasury is the only borrower in the model. It issues longer-term Treasury debt and short-term Treasury bills. The Fed holds both longer-term Treasury debt and Treasury bills. For simplicity, we assume the Fed's only liabilities are reserves held by banks.

A. Key Actors

As noted above, the framework has five key actors—households, banks, dealers, the Fed, and the Treasury. The basic behavioral relationships for each sector are described below.

Households

Households have a fixed amount of wealth, W, that they invest in repo, longer-term Treasury securities, and deposits. Households regard these assets as imperfect substitutes, and the assumed household asset demand functions are of the form:

$$HH_P = Household\ Lending\ Repo\ Markets = HH_P(R_{LT}, R_{P,}R_D)$$

$$HH_{LT} = Household\ Holdings\ of\ LongTerm\ Treasury\ Debt = HH_{LT}(R_{LT}, R_{P,}R_D)$$

$$HH_D = Household\ Holdings\ of\ Deposits = \ HH_D(R_{LT}, R_{P,}R_D)$$

with

$$HH_P + HH_{LT} + HH_D = W$$

Above, $R_{LT}, R_{P,}R_D$ are the market rates on long-term Treasury debt, repurchase agreements, and deposits, respectively. For the purpose of this note, the asset demand functions are assumed to be linear functions of interest rate spreads with the coefficients $a, b, c, and\ d$ below all positive. The terms hhp and $hhlt$ in the expressions below are constants representing baseline shares of wealth in the form of household holdings of repo and longer-term Treasury securities.

$$HH_P(R_{LT}, R_P, R_D) \ = hhp \cdot W + a \cdot (R_P - R_{LT}) + b \cdot (R_P - R_D)$$

$$HH_{LT}(R_{LT}, R_P, R_D) = hhlt \cdot W + c \cdot (R_{LT} - R_P) + d \cdot (R_{LT} - R_D)$$

The asset demand function for deposits is defined implicitly by the demand functions for repo and longer-term Treasury securities along with the wealth constraint on household investments.

$$HH_D(R_{LT}, R_P, R_D) = (1 - hhp - hhlt) \cdot W + (c + d - a) \cdot (R_D - R_{LT}) + (a + b - c) \cdot (R_D - R_P)$$

---

[19] See Chen et. al. (2016) The Federal Reserve's Policy Normalization Tools in a Preferred Habitat Model of Financial Markets, Clouse (2024) A Field Guide to Monetary Policy Implementation Issues in a New World with CBDC, Stablecoin, and Narrow Banks, and Brainard and Tobin (1969) A General Equilibrium Approach To Monetary Theory.

We assume the parameters a, b, c, d are set so that the coefficients on the spread terms for the asset demand function for deposits are positive—that is, an increase in the deposit rate relative to the long-term Treasury rate or the repo rate results in higher demand for deposits.

Dealers

Dealers invest in longer-term Treasury securities financed in the repo market and face balance sheet costs that are a function of the size of their holdings of longer-term securities. Dealers seek to maximize profits given by:

$$R_{LT} \cdot DL_{LT} - R_P \cdot DL_P - \frac{\delta}{2} \cdot DL_{LT}^2$$

Here DL_{LT} and DL_P represent dealer holdings of longer-term Treasury securities and dealer repo liabilities, respectively. The first order condition then is:

$$R_{LT} - R_P - \delta \cdot DL_{LT} = 0$$

The dealer balance sheet constraint implies $DL_{LT} = DL_P$.

Banks

Bank invest in assets including reserves, Treasury bills, and lending in repo markets. Bank assets are funded by domestic deposits and foreign deposits. Foreign deposits are supplied elastically at the market clearing deposit rate. Banks potentially face two types of costs associated with the composition of their asset portfolios.

One type of cost is a function of the magnitude of lending in repo markets.

$Repo\ Cost = \frac{\omega}{2} \cdot (BK_P - BK_P^*)^2$ when $BK_P \geq BK_P^*$ and 0 otherwise.

Another type of cost is a function of the magnitude of their reserve holdings. In particular, banks face a liquidity cost given by:

$Liquidity\ Cost = \frac{\tau}{2} \cdot (BK_{RES}^* - BK_{RES})^2$ when $BK_{RES} \leq BK_{RES}^*$ and 0 otherwise.

Banks seek to maximize profits given by:

$$R_{TB} \cdot BK_{TB} + i \cdot BK_{RES} + R_P \cdot BK_P - R_D \cdot D - Repo\ Cost - Liquidity\ Cost$$

In the expressions above, BK_P, BK_{RES}, BK_{TB} are bank holdings of repo, reserves, and Treasury bills, respectively. The variable D represents bank deposits, both domestic and foreign. Here i is the interest rate on reserve balances set by the Fed. Given the thresholds that determine when repo costs and liquidity costs come into play, there are four cases that characterize bank behavior—unconstrained, active repo costs, active liquidity costs, and both active repo costs and active liquidity costs.

In the case in which the bank is unconstrained, banks are able to freely arbitrage across the markets in which they operate. As a result,

$$R_P = R_{TB} = i = R_D$$

In the case in which only repo costs are active, profit maximizing behavior requires:

$$R_P - \omega \cdot (BK_P - BK_P^*) = R_{TB} = i = R_D$$

In effect, this relationship describes an upward sloping bank supply curve for repo financing as a function of the spread of the repo rate over the interest rate on reserve balances once bank repo lending moves above the threshold BK_P^*.

In the case in which only liquidity costs, profit maximizing behavior requires:

$$R_P = R_{TB} = i + \tau \cdot (BK_{RES}^* - BK_{RES}) = R_D$$

This relationship describes the familiar downward sloping reserve demand curve as a function of the spread of the repo rate (and Treasury bill rate) over the interest rate on reserve balances once bank reserves fall below the threshold BK_{RES}^*.

And the case when both repo costs and liquidity costs are active, profit maximizing behavior requires:

$$R_P - \omega \cdot (BK_P - BK_P^*) = R_{TB} = i + \tau \cdot (BK_{RES}^* - BK_{RES}) = R_D$$

Treasury and Federal Reserve

The Fed is assumed to hold both short- and long-term Treasury securities. For simplicity we assume the only liabilities of the Fed are reserve balances. The Fed's balance sheet is then described by:

$$FED_{Assets} = FED_{ShortTerm} + FED_{LongTerm} = FED_{Liabilities} = FED_{Reserves}$$

The Treasury issues short-term debt (TRE_{TB}) and long-term debt (TRE_{LT}). Short-term Treasury debt by assumption does not play a significant role in the model. However, the Fed can adjust the quantity of reserves outstanding in the banking system by adjusting its holdings of Treasury bills with no ancillary effects in other markets. As a result, such operations are a useful device to cleanly separate open market operations that have market effects solely through their influence on reserve scarcity. In contrast, Fed open market operations in long-term Treasury debt potentially have effects both through impacts on reserve scarcity and by affecting demand and supply conditions in long-term Treasury debt markets.

B. Market Clearing and Equilibrium Rates

The market clearing conditions depend on whether repo costs, liquidity costs, or both come into play for banks.

Banks Unconstrained

When banks are unconstrained by repo and liquidity costs, market clearing conditions in the Treasury market and repo market are given by:

$$TRE_{LT} = FED_{LT} + HH_{LT}(R_{LT}, R_P, R_D) + DL_{LT} \quad (1)$$

$$DL_{LT} = (R_T - i)/\delta = HH_P(R_{LT}, R_P, R_D) + BK_P \quad (2)$$

With $R_P = R_D = i$ (3)

Combining equations (1) and (2) and (3)

$$TRE_{LT} = FED_{LT} + HH_{LT}(R_{LT}, i, i) + (R_{LT} - i)/\delta \qquad (4)$$

The equilibrium Treasury rate then is the value of R_{LT} that solves equation (4). All else equal, an increase in the total supply of long-term Treasury debt, TRE_{LT}, pushes up the equilibrium Treasury rate. And, again all else equal, an increase in the Fed's holding of long-term Treasury debt puts downward pressure on long-term Treasury yields.

The amount of bank lending in the repo market in equilibrium fills the gap between dealer demand for repo financing and household lending in repo markets:

$$BK_P = \frac{R_{LT} - i}{\delta} - HH_P(R_{LT}, i, i) \qquad (5)$$

Bank holdings of reserves and Treasury bills are then given by:

$$BK_{Res} = FED_{Assets}$$

And bank holdings of Treasury bills are given by:

$$BK_{TB} = TRE_{TB} - FED_{TB}$$

The comparative statics in this equilibrium are straightforward. An increase in long-term Treasury debt outstanding puts upward pressure on the Treasury yield, increases bank lending in the repo market, reduces household lending in the repo and deposit markets, and increases the quantity of foreign deposits.

Active Repo Lending Costs with Elevated Repo Lending

For cases in which bank lending in the repo market exceeds the threshold value, BK_P^*, the equilibrium is described by:

$$TRE_{LT} = FED_{LT} + HH_{LT}(R_{LT}, R_P, R_D) + DL_{LT} \qquad (6)$$

$$DL_{LT} = (R_{LT} - R_P)/\delta \qquad (7)$$

$$DL_p = HH_P(R_{LT}, R_P, R_D) + BK_P \qquad (8)$$

$$DL_{LT} = DL_P \qquad (9)$$

$$BK_P = BK_P^* + (R_P - R_D)/\omega \qquad (10)$$

$$R_D = i \qquad (11)$$

In this setting, the repo rate must move to clear markets. The equilibrium described by equations (6)-(11) can be depicted as the intersection of two lines. Beyond a certain point, an increase in long-term Treasury debt outstanding pulls up both the long-term Treasury rate and the repo rate even though bank reserves are plentiful and banks have ready access to liquidity. The spread between the long-term Treasury yield and repo rate widens induing dealers to hold larger inventories of securities. Banks provide more repo financing as the spread of the repo rate over IORB widens. Households may provide more or less repo financing depending on the relative strength of substitution effects between repo and Treasury securities and repo and deposits. Conversely, an increase in the Fed's holdings of long-term Treasury debt puts downward pressure on the long-term Treasury yield and repo rate. Given the structure of the model, Treasury issuance of Treasury bills or Fed purchases of Treasury bills have no effect on repo rates in this region. The Treasury bill rate and deposit rate remain pegged at the interest rate on reserve balances.

Active Liquidity Costs with Low Reserves

For cases in which bank reserves fall below the threshold value, BK^*_{RES}, and bank repo lending is below the threshold value, BK^*_P, the equilibrium is described by:

$$TRE_{LT} = FED_{LT} + HH_{LT}(R_{LT}, R_P, R_D) + DL_T \quad (12)$$

$$DL_{LT} = (R_{LT} - R_P)/\delta \quad (13)$$

$$DL_P = HH_P(R_{LT}, R_P, R_D) + BK_P \quad (14)$$

$$DL_{LT} = DL_P \quad (15)$$

$$R_P = i + \tau \cdot (BK^*_{RES} - BK_{RES}) \quad (16)$$

$$R_D = i + \tau \cdot (BK^*_{RES} - BK_{RES}) \quad (17)$$

$$BK_{RES} = FED_{Assets} \quad (18)$$

The equilibrium in this case is similar to that described for the unconstrained case except that the repo rate, deposit rate, and Treasury bill rate are now affected by the scarcity value of reserves.

Both Active Repo Costs and Active Liquidity Costs

For the case when banks face both repo lending costs and liquidity costs, the market clearing conditions become:

$$TRE_{LT} = FED_{LT} + HH_{LT}(R_{LT}, R_P, R_D) + DL_T \quad (19)$$

$$DL_{LT} = (R_{LT} - R_P)/\delta \quad (20)$$

$$DL_P = HH_P(R_{LT}, R_P, R_D) + BK_P \quad (21)$$

$$DL_{LT} = DL_P \quad (22)$$

$$BK_P = BK^*_P + (R_P - R_D)/\omega \quad (23)$$

$$R_D = i + \tau \cdot (BK^*_{RES} - BK_{RES}) \quad (24)$$

$$R_D = R_{TB} \quad (25)$$

$$BK_{RES} = FED_{Assets} \quad (26)$$

The equilibrium in this case is similar to that in the case with only active repo costs except that the deposit rate and Treasury bill rate are now influenced by the scarcity value of reserves. Given the assumed form of the household asset demand functions, an increase reserve scarcity that is not associated with changes in the Fed's holdings of longer-term Treasury debt only indirectly affects the Treasury market equilibrium condition in (19) through the deposit rate. An increase in reserve scarcity of this type does also affects the repo market equilibrium line and puts upward pressure on all interest rates in the model.

Observations on Interest Rate Determination

An important feature of the model is that the deposit rate in all regimes is determined by the Federal Reserve through the setting of the IORB and the degree of scarcity of reserves. When reserves are ample, the deposit rate is equal to IORB; when reserves are scarce, the deposit rate is equal to IORB plus the marginal liquidity value of reserves. Moreover, all of the asset demands in the model are functions of interest rate spreads. As a result, if the level of the deposit rate moves up as a result of an increase IORB or Fed sales of Treasury bills that increase the marginal liquidity value of reserves, the levels of all other rates in the model move up by the same amount, leaving all the interest rate spreads unchanged. These observations imply that both the long-term Treasury rate and repo rate can be decomposed as:

$$Repo\ Rate = IORB + (Deposit\ Rate - IORB) + Other\ Factors$$

$$Long\_Term\ Treasury\ Rate = IORB + (Deposit\ Rate - IORB) + Other\ Factors$$

The second term in these expressions captures the scarcity value of reserves, if any. The other factors term captures the effect of fiscal pressures and the willingness of banks, dealers, and households to hold different types of financial assets.

Regime Switching to Active Repo Costs

The condition determining when banks will start to face repo lending costs is determined from equation (5) and the assumed form of the household asset demand function as:

$$BK_P^* = (\tfrac{1}{\delta} + a) \cdot (R_{LT}^* - R_D) - hhp \cdot W$$

Note that in any regime in which repo costs are not active, $R_P = R_D$ and the level of R_D is pinned down by the IORB and the Fed-determined degree of reserve scarcity. Here R_{LT}^* is the value of the long-term Treasury rate that results in bank repo lending at a level exactly equal to the threshold level, BK_P^*, at which bank repo lending costs start to take hold. Whenever the Treasury rate moves above the threshold value R_{LT}^*, banks will tip over into a regime with active repo costs. And based on equation (4), this threshold value of the long-term Treasury rate is determined by the holdings of longer-term securities in the private sector which, in turn, is determined by the Treasury's issuance of long-term securities less the Fed's holdings of long-term securities. Note that if the Fed operates in an ample reserve regime, the deposit rate is determined by IORB and changes in IORB pass through one for one to changes in the threshold value of the long-term Treasury yield. If the Fed operates in a scarce reserves regime, the deposit rate is determined by a combination of IORB and the degree of reserve scarcity. In this case, changes in reserve scarcity also pass through one for one to the threshold value of the long-term Treasury yield.

SRF

Incorporating the standing repo facility in the model makes the quantity of reserves in the banking system endogenous. When dealers turn to the SRF for financing, the repo rate is equal to the SRF rate, $R_P = R_{SRF}$. When reserves are ample, the deposit rate remains pegged at IORB. The long-term Treasury rate is then determined by modified versions of equation (6) and (7) as:

$$TRE_{LT} = FED_{LT} + HH_{LT}(R_{LT}, R_{SRF}, i) + DL_{LT} \quad (6')$$

$$DL_{LT} = (R_{LT} - R_{SRF})/\delta \quad (7')$$

With all the endogenous rates determined, the quantity of Fed SRF financing, FED_{SRF}, is determined by the gap between dealer demand for financing and the financing available from households and banks:

$$DL_p = HH_P(R_{LT}, R_{SRF}, i) + BK_P + FED_{SRF} \quad (8')$$

$$DL_{LT} = DL_P \quad (9')$$

$$BK_P = BK_P^* + (R_{SRF} - i)/\omega \quad (10')$$

Total bank reserve holdings are then determined by the sum of the Fed's securities holdings plus the quantity of repo financing provided through the SRF. Total bank assets are determined as the sum of reserves, Treasury bills issued by the Treasury, and lending in repo markets determined by equation (10'). Bank assets are funded by deposits including domestic deposits given by $HH_{DEP}(R_{LT}, R_{SRF}, i)$ with any residual deposit funding from foreign deposits.

The case with an SRF when both liquidity and repo lending costs are active is more complicated because borrowing from the SRF affects both the Treasury market equilibrium line and the repo market equilibrium line. By assumption, the repo rate is again determined by the SRF rate. However, the deposit rate is now a function of the quantity of SRF borrowing through its effect on the quantity of reserves in the banking system. The equilibrium long-term Treasury yield and the equilibrium quantity of SRF borrowing are simultaneously determined in modified versions of equation (19) through (24). All other rates and quantities can then be derived by plugging these values back into the underlying behavioral relationships and accounting identities.

Graphical Representation

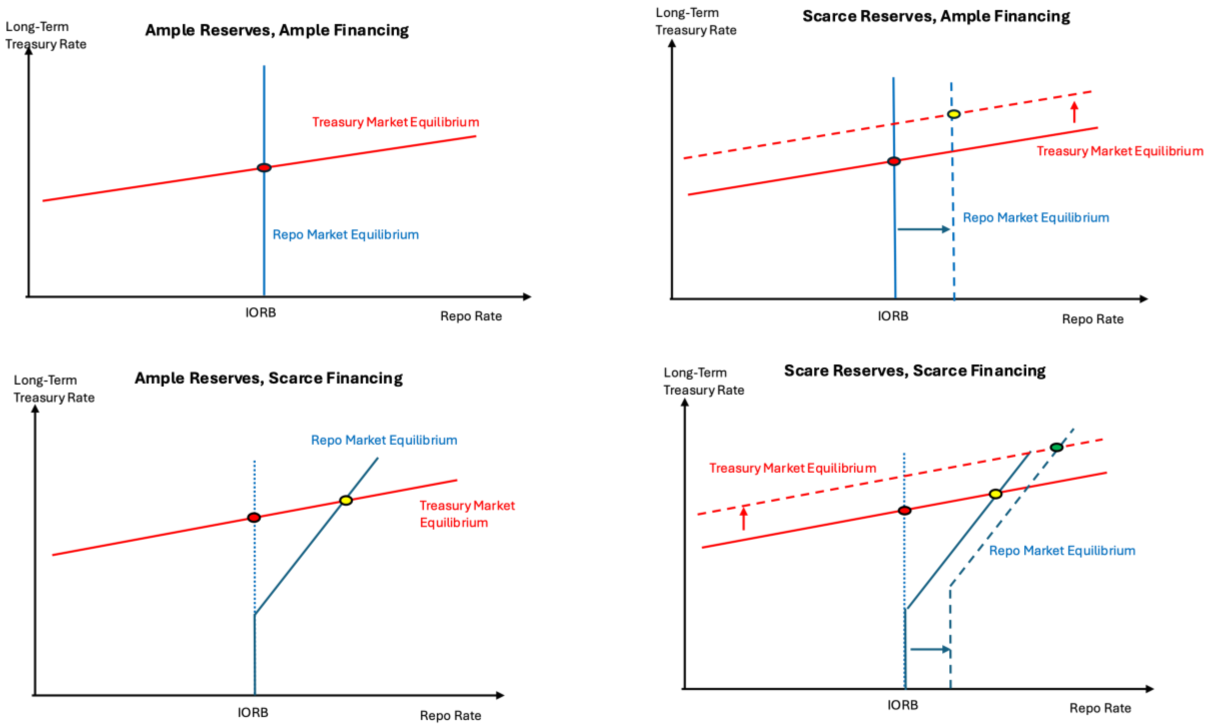
Figure A-1 provides a graphical representation of these four regimes. The upper left panel shows the equilibrium that results when banks are unconstrained. The repo is fixed at the level of IORB, and the intersection of the vertical repo market equilibrium line and the upward sloping Treasury market equilibrium curve (red line) determines the level of long-term rates.

The upper right panel displays the equilibrium that results when reserves fall below ample levels. In this case, the repo rate and all other short-term interest rates are pushed above IORB, but the repo market equilibrium line remains vertical because banks are still willing to arbitrage across reserves, repo lending, and Treasury bills at this higher rate. The Treasury market equilibrium line shifts up because, all else equal, the increase in short-term interest rates depresses household and dealer demand for longer-term Treasury securities. The shifts in the repo market equilibrium line and Treasury market equilibrium lines push Treasury rates higher, moving from the red dot to the yellow dot. The increase in the long-term Treasury rate and repo rate is equal to the increase in the deposit rate.

The bottom left panel displays the results when bank repo costs come into play while reserves remain ample above the threshold value. In this scenario, the repo market equilibrium line becomes upward sloping beyond the repo threshold point and the equilibrium repo rate and long-term Treasury rate both move higher than in the case with unconstrained banks. The deposit rate and Treasury bill rate remain anchored by the IORB rate.

The bottom right panel displays the case when both liquidity costs and repo costs are present. The upward sloping repo market equilibrium line shifts to the right. In addition, the Treasury market equilibrium line shifts up reflecting the effects of reserve scarcity on short-term interest rates. In this case, the Treasury bill rate and deposit rate are also pushed above the IORB rate by the increase in the marginal liquidity value of reserves. The threshold value of the long-term Treasury yield at which repo costs come into play moves up by the same amount. The increase in the long-term Treasury rate and repo rate stemming from the increase in the marginal liquidity value of reserves matches the increase in the deposit rate and Treasury bill rate.

Figure A-1



References

Acharya, Viral V., Rahul S. Chahaun, Raghuram Rajan, and Sascha Steffen (2024). "Liquidity Dependence and the Waxing and Waning of Central Bank Balance Sheets," NBER Working Paper 31050, National Bureau of Economic Research, Liquidity Dependence and the Waxing and Waning of Central Bank Balance Sheets.

Afonso, Gara, Gabriela La Spada, Thomas M. Mertens, and John C. Willaims (2023). "The Optimal Supply of Central Bank Reserves under Uncertainty," Federal Reserve Bank of New York, Staff Reports, number 1077, The Optimal Supply of Central Bank Reserves under Uncertainty,

Anbil, Sriya, Alyssa Andersen, and Zeynep Senyuz (2020). "What Happened in Money Markets in September 2019?," FEDS Notes, February, What Happened in Money Markets in September 2019?

Anbil, Sriya, Alyssa Andersen, Romina Ruprecht and Ethan Cohen (2024). "Stop Believing in Reserves," SSRN Working Paper, April, Stop Believing in Reserves.

Copeland, Adam, Darrell Duffie, and Yilin (David) Yang (2024). "Reserves Were Not So Ample After All," Quarterly Journal of Economics, October, Reserves Were Not So Ample After All .

Chen, Han, James Clouse, Jane Ihrig, Elizabeth Klee (2016). "The Federal Reserve's Policy Normalization Toos in a Preferred Habitat Model of Financial Markets," Journal of Money, Credit, and Banking, August, 48(5), The Federal Reserve's Policy Normalization Tools in a Preferred Habitat Model of Financial Markets.

Clouse, James A. (2024). "A Field Guide to Monetary Policy Implementation in a New World with CBDC, Stablecoin, and Narrow Banks," FEDS Working Paper, 2024-001, A Field Guide to Monetary Policy Implementation Issues in a New World with CBDC, Stablecoin, and Narrow Banks.

Clouse, James A. and Khia Kurtenbach (2025). "Federal Reserve Independence, Federal Finance, and the Uneasy Relationship," Andersen Institute Note, September, Federal Reserve Independence, Federal Finance, and the Uneasy Relationship.

Clouse, James A., Sebastian Infante, and Zeynep Senyuz (2025). "Market-Based Indicators on the Road to Ample Reserves," FEDS Notes, January, Market-Based Indicators on the Road to Ample Reserves.

Duffie, Darrell, Michael Fleming, Frank Keane, Claire Nelson, Or Shachar, and Peter Van Tassel (2023). "Dealer Intermediation Capacity and U.S. Treasury Market Functionality," Federal Reserve Bank of New York Staff Reports, Number 1070, August, Dealer Intermediation Capacity and U.S. Treasury Market Functionality.

Ihrig, Jane E., Ellen E. Meade, and Gretchen C. Weinbach (2015). "Rewriting Monetary Policy 101: What's the Fed's Preferred Post-Crisis Approach to Raising Interest Rates," Journal of Economic Perspectives, 29(4), Rewriting Monetary Policy 101: What's the Fed's Preferred Post-Crisis Approach to Raising Interest Rates?,

Logan, Lorie and Sam Schulhofer-Wohl (2025). "Options for modernizing the FOMC's operating target interest rate," In Depth, Federal Reserve Bank of Dallas, September, Options for modernizing the FOMC's operating target interest rate.

Lopez-Salido, David and Annette Vissing-Jorgenson (2023). "Reserve Demand, Interest Rate Control, and Quantitative Tightening," SSRN Working Paper, March, Reserve Demand, Interest Rate Control, and Quantitative Tightening.

Perli, Roberto (2024). "Balance Sheet Normalization: Monitoring Reserve Conditions and Understanding Repo Market Pressures," remarks at the U.S. Treasury Market Conference, Balance Sheet Normalization: Monitoring Reserve Conditions and Understanding Repo Market Pressures.