



Fed policy implementation plumbing

The plumbing of the US monetary policy system will likely move into the market spotlight in coming weeks and months as the Fed revisits its implementation framework. The August FOMC meeting minutes indicated that “the Committee would likely resume a discussion of operating frameworks in the fall” and we expect these discussions to pick up relatively soon. This document is intended to review the key elements of the Fed’s plumbing, including tools the Fed has to implement monetary policy, the changing dynamics of the fed funds market, shifts in the post-crisis reserves backdrop, and the Fed’s key framework considerations for the future. We also contrast the current state of policy implementation with the pre-crisis regime in the [appendix](#).

The basics

The Fed sets a 25 bps range for the effective federal funds rate, which is their primary objective for setting monetary policy. The Fed sees their key policy tools, interest on excess reserves and the overnight reverse repo facility, as flexible in achieving this outcome. The Fed also has a backstop lending facility, the discount window, which it sets 50 bps above the top of its target EFR range.

Changing dynamics in fed funds

The current state of the fed funds market is highly idiosyncratic: lending activity is dominated by the Federal Home Loan Banks, while borrowing activity has previously been concentrated among foreign banks but is now shifting more towards domestic banks. Evolving behavior from these players, as well as higher overall money market rates, has pushed the effective fed funds rate upwards in the Fed’s target range.

Post-crisis shift in reserves

The Fed’s current toolkit is only necessary because of the large amount of bank reserves currently in the system. In an abundant reserve framework, there is limited competition for reserves because they are plentiful by design. This has kept the effective fed funds rate below IOER and ensured that banks have been relatively flush with cash. This surplus of reserves came about during the financial crisis, when the Fed initiated crisis lending programs and engaged in large scale asset purchase programs (i.e. QE). Reserve increases were initially concentrated at foreign (FBOs) and large domestic banks; we believe the largest concentration of reserve reduction will come from FBOs while large domestic banks will be reluctant to see reserves decline due to regulatory constraints.

Fed policy framework choices

The Fed will likely be actively debating their choice of monetary policy framework in coming weeks and months. They essentially have two options: return to a pre-crisis reserve scarce “corridor system”, or maintain the current reserve abundant “floor system”. We suspect the Fed is leaning towards maintaining a floor instead of a corridor system for their longer-run policy framework. We believe the Fed sees the floor system as working well at present, easy to implement, not requiring frequent open market operations, and ensuring plentiful reserves for the banking system to meet regulatory requirements. As a part of the framework discussions, the Fed may also reconsider their policy target and look to incorporate SOFR (secured overnight financing rate) more directly in their policy setting regime.

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Rates Strategy
United States

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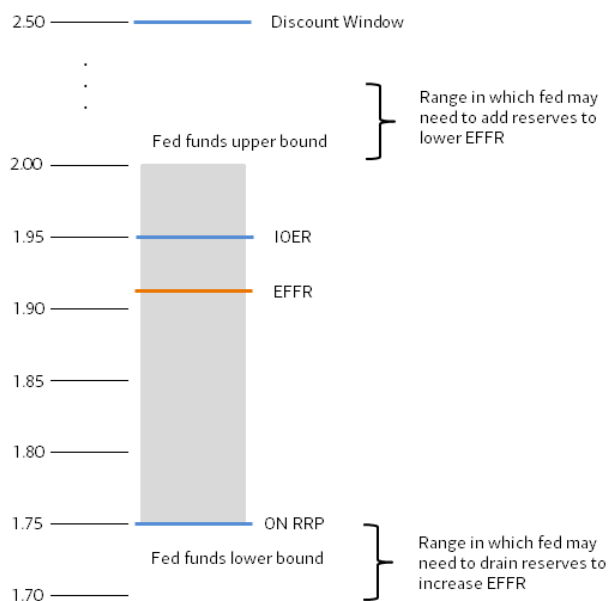
Fed plumbing: the piping

The US system of monetary policy will move into the market spotlight as the Fed revisits its “implementation framework” in coming months. The August FOMC meeting minutes indicated that “the Committee would likely resume a discussion of operating frameworks in the fall” and we expect these discussions to pick up between the September and November meetings. This document is intended to review the key elements of the Fed’s plumbing, including tools the Fed has to implement monetary policy, the changing dynamics of the fed funds market, shifts in the post-crisis reserves backdrop, and the Fed’s key framework considerations for the future. We also contrast the current Fed policy implementation regime with the pre-crisis regime in the [appendix](#).

Fed policy implementation: the basics

The Fed sets monetary policy to promote its dual mandate of maximum employment and stable inflation.¹ The Fed achieves these goals by managing the level of short-term interest rates and specifically sets a 25 bps range for its target effective federal funds rate (EFFR), which represents overnight unsecured interbank borrowing. To achieve this 25 bps range, the Fed relies on the interest rate it pays on excess reserves (IOER) and an overnight reverse repo facility (ON RRP). The Fed also has a backstop lending facility, the discount window, which is 50 bps above the top of its target EFFR range (Exhibit 1). We discuss each of these targets and tools in greater detail below.

Exhibit 1: Current Fed policy target and key interest rates



Source: BofA Merrill Lynch Global Research, Federal Reserve

Target range for the fed funds effective rate

The Fed sets a 25 bps range for the EFFR, which is its primary objective for setting monetary policy. The Fed’s key policy tools, IOER and ON RRP, can be set to any rate of interest in order to ensure that the EFFR remains within the Fed’s 25bps target range.

If the EFFR were to trade outside of the Fed’s 25 bps target range, the FOMC has given standing orders to the Open Market Desk at the Federal Reserve Bank of New York (the Desk) to undertake open market operations to move the EFFR back into this range. Specifically, the most recent implementation note from the August meeting states that

¹<https://www.federalreserve.gov/monetarypolicy/monetary-policy-what-are-its-goals-how-does-it-work.htm>

the FOMC “directs the Desk to undertake open market operations as necessary to maintain the federal funds rate in a target range of 1-3/4 to 2 percent”. We interpret this to mean that if the EFFR were to trade persistently above the top end of the target range, the Desk would be required to engage in reserve adding open market operations in order to place downward pressure on the EFFR (i.e. Fed buys Treasuries and funds them with reserves via repos or outright purchases). Conversely, the Fed’s ON RRP facility is more greatly utilized when the EFFR trades at the lower end of the Fed’s target range and the Fed could consider other tools to reduce reserves if needed (Exhibit 1).²

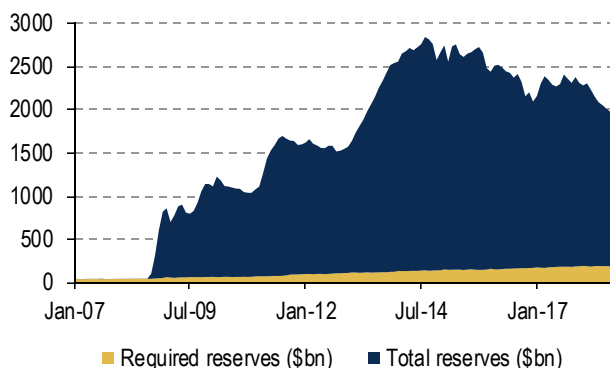
IOER (Interest on Excess Reserves)

This is the main tool that the Fed uses to move the FF rate within the target range. It is the rate of interest paid to depository institutions for their required and excess balances held overnight at the Fed. It is set by the Board of Governors (not the FOMC).

The Fed has the ability to pay banks two separate rates of interest: one on required and the other on excess reserves (Chart 1). The Fed states that interest is paid on required reserves to eliminate “the implicit tax that reserve requirements used to impose on depository institutions”.³ The Fed has always offered the same level of interest on required and excess reserves but could choose to offer different levels of interest if it desired. The Fed’s ability to pay interest on required and excess reserves is a relatively new policy tool as Congress only granted the Fed ability to pay interest on reserves in the fall of 2008. IOER was not a part of the Fed’s pre-crisis policy toolkit.

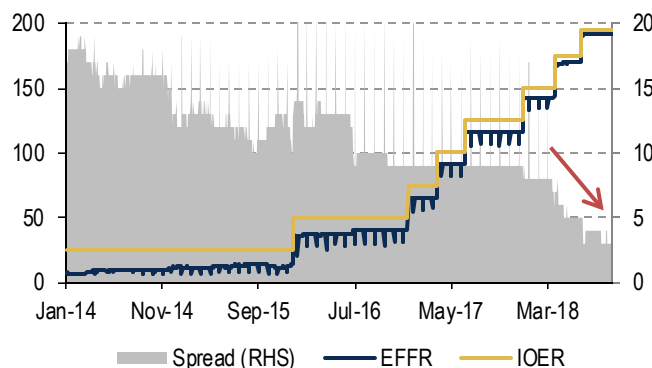
IOER is only eligible for depository institutions and is not available to other entities that can transact in the federal funds market, such as government sponsored enterprises (GSEs). In theory, no bank that can earn interest at the Fed should be willing to lend below IOER; however, in practice the EFFR currently trades below IOER (Chart 2). This is because GSEs would prefer to earn a positive return by lending their excess cash to an entity willing to pay a positive rate of return (even if below IOER) instead of leaving these funds on account at the Fed earning zero. The inability for the GSEs to earn IOER drives the vast majority of current lending activity in the FF market.

Chart 1: Required reserves and total reserves



Source: Federal Reserve, BofA Merrill Lynch Global Research

Chart 2: IOER-FF spread around 3bps since mid-August (bps)



Source: NY Fed, BofA Merrill Lynch Global Research

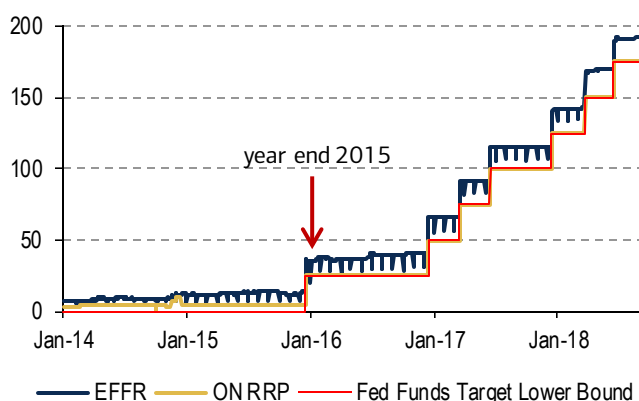
ON RRP Facility (Overnight Reverse Repurchase Agreement)

The Fed’s ON RRP facility is a supplementary tool to prevent the EFFR from trading below the bottom of the 25 bps target range. Since the Fed introduced ON RRP in 2013 it has served as a relatively firm floor for overnight Treasury GC repo and kept the EFFR above the bottom end of the Fed’s 25 bps target range on all days except one (year-end 2015) (Chart 3).

² For example, the Fed could utilize the term deposit facility if EFFR was too low in the range

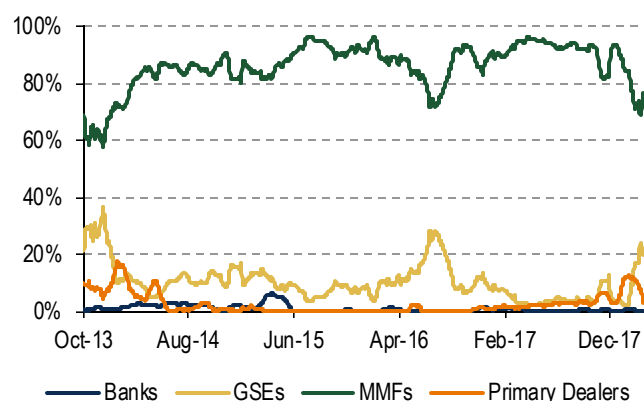
³ <https://www.federalreserve.gov/monetarypolicy/reqresbalances.htm>

Chart 3: ON RRP acts as firm floor for EFFR (bps)



Source: BofA Merrill Lynch Global Research, Bloomberg

Chart 4: ON RRP usage as % of total



Note: data as of March 2018; Source: FRBNY, BofA Merrill Lynch Global Research

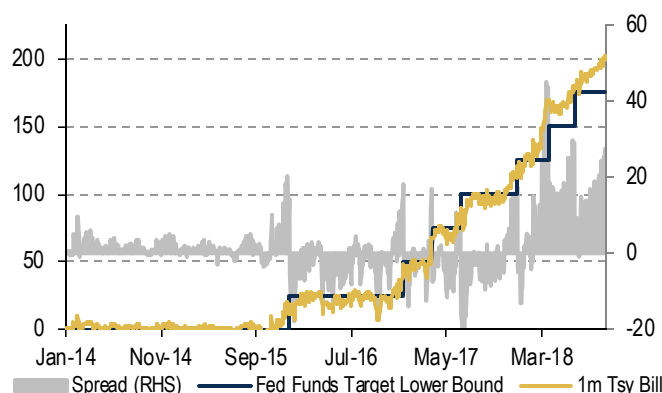
ON RRP can essentially be thought of as an investment option of last resort for eligible counterparties. An ON RRP eligible counterparty would only invest with the Fed if there were no other readily available higher yielding alternative investments (Chart 4, Table 1). In theory, entities that have access to the Fed's facility should not be willing to invest in overnight secured or unsecured transactions at a rate below ON RRP (since the Fed has better credit risk vs any private counterparty). ON RRP does not provide a firm floor on all money market rates since not all market participants have access to it. This is why short-tenor Treasury bill rates frequently traded through the bottom end of the Fed's target range prior to the large increase in deficit funding in 2018 (Chart 5).

Table 1: Eligible ON RRP counterparties

Type	Number	% Historical Usage
GSEs	14	10%
Banks	16	1%
Primary Dealers	23	3%
Money Funds	100	86%

Source: FRBNY, BofA Merrill Lynch Global Research

Chart 5: 1M T-bills traded through Fed lower bound in the past (bps)



Note: FF lower bound & 1m T-bill on LHS; spread on RHS; source: BofA Merrill Lynch Global Research, Bloomberg

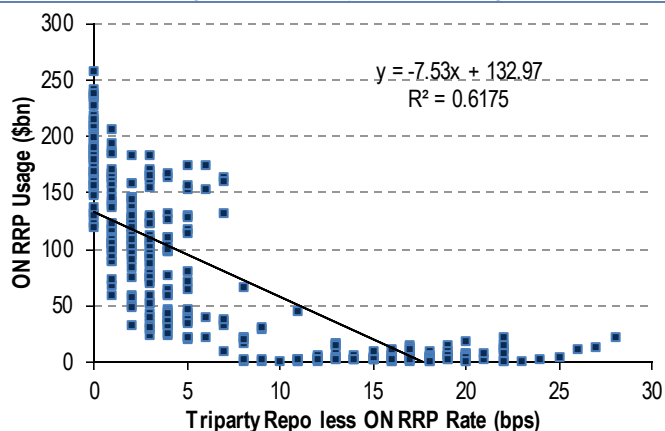
There are currently 153 eligible counterparties that have access to the Fed's ON RRP facility, spanning primary dealers, banks, GSEs, and money market mutual funds. Most of the historical ON RRP usage was driven by MMF, followed by GSEs, primary dealers, and banks (Chart 4, Table 1). The Fed has previously indicated that money fund eligible counterparties comprised about 70% of total US MMF AUM and that these firms accounted for >25% of total tri-party repo lending against government collateral.⁴ The large set of counterparties that are able to invest directly with the Fed both in terms of number and share of money market activity explains why the ON RRP has proven to be such an effective floor on USD short-dated interest rates.

Usage of the Fed's ON RRP facility is inversely related to the level of money market rates vs the bottom end of the Fed's target range. When Treasury collateral is scarce

⁴ See Potter, "Money Markets and Monetary Policy Normalization", <https://www.newyorkfed.org/newsevents/speeches/2015/pot150415.html>

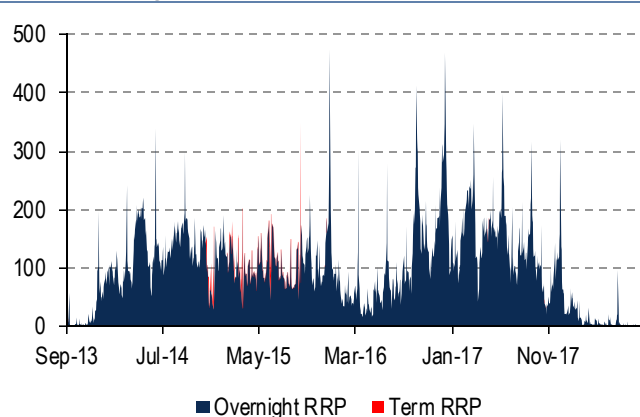
and repo rates are relatively low, usage of the Fed's ON RRP increases (and vice versa) (Chart 6). ON RRP usage has tended to spike around month and quarter end reporting dates when some banks shrink their balance sheets, limiting overnight investment options for cash rich money market participants (Chart 7). At present, usage of the Fed's ON RRP facility is virtually zero on most days since the general structure of money market rates has increased with higher Treasury supply since early 2018 (Chart 8).

Chart 6: ON RRP usage declines as repo rates shift higher



Note: data excludes 7 business days before and 5 days after quarter end dates; Source: BofA Merrill Lynch Global Research, BNY Mellon

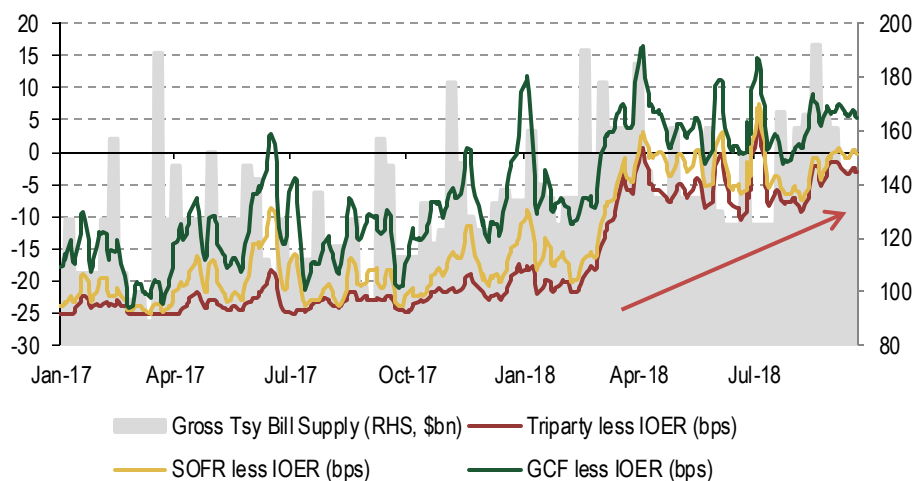
Chart 7: RRP Usage



Source: Federal Reserve, BofA Merrill Lynch Global Research

The Fed has stated that it will use ON RRP “only to the extent necessary and will phase it out when it is no longer needed to help control the federal funds rate”. The Fed has given no indication it will be looking to phase out the ON RRP in the near future even though usage in the facility has waned. We expect the ON RRP to remain a key policy tool for the Fed until they make broader decisions around their longer-run monetary policy framework.⁵

Chart 8: Current structure of money market rates and Treasury bill supply



Note: rates are 5D moving average; Source: BofA Merrill Lynch Global Research, Bloomberg

EFFR (effective Federal Funds Rate) & OBFR (overnight bank funding rate)

The EFFR is the primary monetary policy target for the Fed. According to the NY Fed, the EFFR “consists of domestic unsecured borrowings in U.S. dollars by depository institutions from other depository institutions and certain other entities, primarily GSEs”. The EFFR is calculated as a volume-weighted median of overnight FF trades.

⁵ <https://www.newyorkfed.org/newsevents/speeches/2017/log170518>

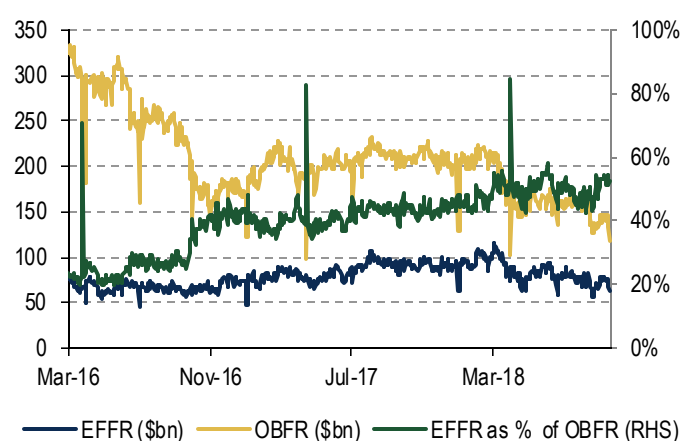
Daily volumes in the overnight EFFR market have declined since the financial crisis: EFFR volumes peaked at around \$250 bn / day prior to the financial crisis and have averaged \$85 bn / day YTD (Chart 9). Today roughly 95% of all FF activity is driven by GSE lending to banks operating in the US, which we discuss further [below](#).

Chart 9: FF volumes have declined post crisis (\$bn)



Note: volumes prior to 2016 are estimated using brokered data from the Fed; source: BofA Merrill Lynch Global Research, NY Fed

Chart 10: EFFR versus OBFR volumes (\$bn)



Source: NY Fed, BofA Merrill Lynch Global Research

Note that the Fed also publishes another broad overnight unsecured bank borrowing rate, the overnight bank funding rate (OBFR). The OBFR consists of overnight FF and certain Eurodollar transactions (Chart 10). According to the NY Fed, the “Eurodollar market consists of unsecured U.S. dollar deposits held at banks or bank branches outside of the United States” and “U.S.-based banks can also take Eurodollar deposits domestically through international banking facilities.” Money market funds, corporations, foreign central banks, and other official accounts are all active lenders in the Eurodollar market which is encapsulated in OBFR (Table 2). Essentially, the EFFR represents overnight unsecured lending activity from the GSEs while OBFR represents overnight unsecured lending from MMFs / corporates / official accounts / others. OBFR is also calculated as a volume-weighted median. Eurodollar funding activity has historically comprised around 70% of OBFR activity, but more recently fed funds and Eurodollar funding activity have each made up about 50% of OBFR activity (Chart 10).

Table 2: Summary of rates used in Fed policy implementation

	Cash Flow	Lender	Borrower	Level
Discount Window	Fed → Needy borrower	Fed offers collateralized loans	Banks in need of funding use the discount window as a last resort	2.50%
IOER	Bank → Fed	Banks leave reserves at the Fed and earn interest	Fed holds reserves and pays interest	1.95%
FF	GSE → Bank	GSEs (mainly FHLBs) lend funds overnight	Domestic banks borrow funds when in need of liquidity. Foreign banks borrow funds to engage in FF-IOER arb	1.92%
OBFR	MMF/Corp/other → Bank	MMFs, corporations, foreign central banks and other official accounts lend in the ED market	Banks borrow funds for liquidity or IOER arb	1.91%
ON RRP	MMF → Fed	MMF lends cash to Fed with an agreement for the cash to be returned on a specified date	Fed sells security to counterparty and agrees to buy it back on a specified date	1.75%

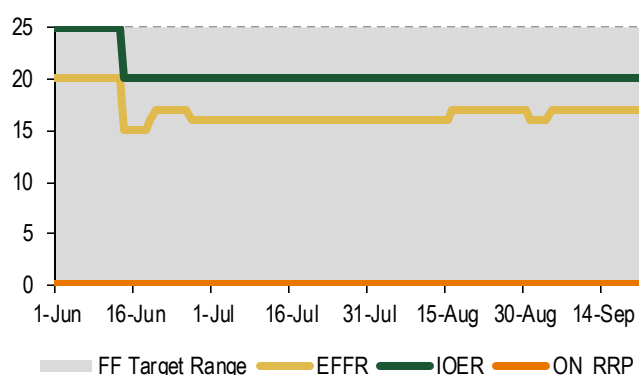
Note: rate levels as of 8/30; Source: BofA Merrill Lynch Global Research, Bloomberg

Changing dynamics in fed funds

The current state of the FF market is highly idiosyncratic: lending activity is dominated by the Federal Home Loan Banks (FHLBs), while borrowing activity has previously been concentrated among foreign banks but is now shifting more towards domestic banks. Evolving behavior from these players pushed the EFFR higher in the Fed’s target range and forced the Fed to only raise the IOER rate by 20 bps in June (Chart 11). We attribute the upward pressure on EFFR to three factors: (1) increased Treasury supply, which changes FHLB overnight investment behavior, (2) regulatory / LCR-related borrowing,

which has likely resulted in more domestic bank borrowing in the FF market, and (3) nascent signs of increased liquidity need / reserve scarcity.

Chart 11: IOER, ON RRP, & fed funds effective in Fed target range (bps)



Source: BofA Merrill Lynch Global Research, Federal Reserve

Chart 12: Recent decline in fed funds volumes (\$bn, 5D MA)



Source: BofA Merrill Lynch Global Research, FRBNY

Participants in the fed funds market

FF lenders: FHLBs are the elephant in the room

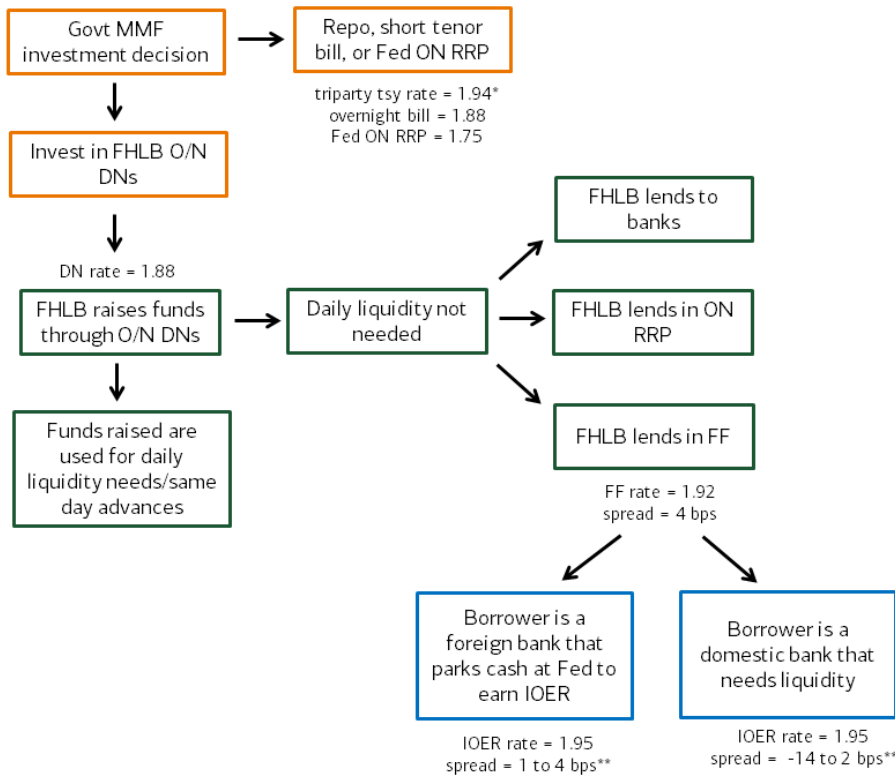
The FHLBs are the dominant lenders in the FF market and the NY Fed has indicated that they currently comprise roughly 95% of total activity.⁶ Recall, the FHLBs are a GSE system of 11 independent regional cooperative banks that provide low cost, collateralized loans to support mortgage lending and related community investment amongst their member institutions. The FHLBs seek to have ample short-term liquidity to meet either the loan or advance needs of their member institutions or to withstand a stressed scenario of reduced market access. The FHLBs use any daily excess cash to invest in positive yielding overnight instruments since they can't earn IOER at the Fed (Exhibit 2).

The FHLBs appear to have three investments for their excess overnight cash: (1) federal funds, (2) Treasury GC repo, and (3) bank deposits. The FHLBs have traditionally preferred investing their overnight excess cash in instruments that offered (a) the highest rate of return, and (b) the earliest return of cash on the trade maturity date. Investing excess cash in FF has historically met both objectives nicely: fed funds offered an average 3 bps pickup to overnight triparty Treasury GC repo in 2017 and fed funds offers an [early return feature](#) that is unavailable through the more rigid triparty Treasury GC repo market, where cash is typically not returned until 3 PM the next day. This dynamic was stable and led to increasing volumes in the fed funds market until Treasury supply increased in Q1 '18 (Chart 12, Chart 13).

Higher supply after the suspension of the debt limit in Q1 '18 caused Treasury GC repo rates to cheapen vs other money market rates. This made alternative investments look more attractive vs FF for the FHLBs and increased their bargaining power in the FF market. FHLBs could demand a higher rate of interest on their FF trades since they could easily shift their investments to the cheaper overnight Treasury GC repo market (Chart 14). This dynamic placed upward pressure on the IOER-FF spread in Q1 '18 and helped put upward pressure on this spread again in Q3 '18.

⁶See Potter, "Confidence in the Implementation of U.S. Monetary Policy Normalization", <https://www.newyorkfed.org/newsevents/speeches/2018/pot180803>

Exhibit 2: FHLB and FF dynamics



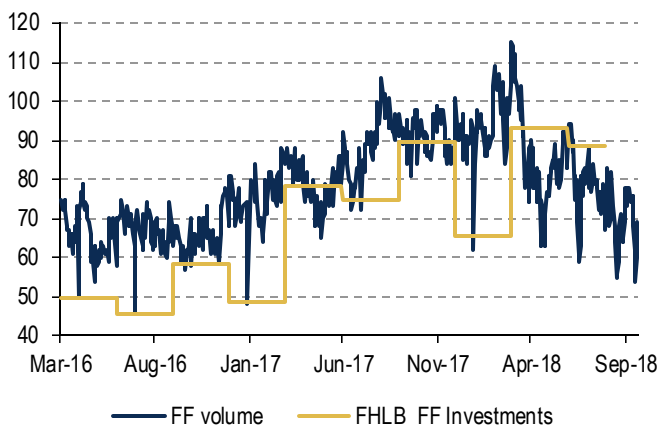
Values as of 8/29

*MMF may be constrained in amount of repo allocation

**Individual banks face different borrowing rates

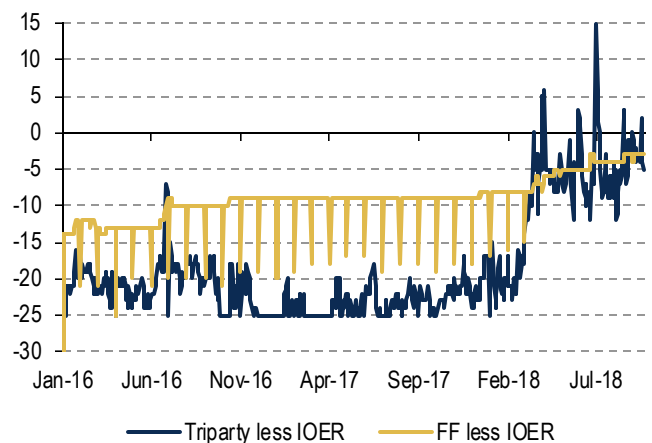
Source: BofA Merrill Lynch Global Research

Chart 13: FHLBs drive fed fund volume levels (\$bn)



Source: BofA Merrill Lynch Global Research, FHLB 10K and 10Q

Chart 14: O/N Tsy tri-party repo has led fed funds higher vs IOER (bps)



Source: BofA Merrill Lynch Global Research, BNY Mellon, Bloomberg

FF borrowers: foreign banks giving way to domestic banks

Borrowing in the FF market has typically been dominated by foreign banks but activity is increasingly shifting to domestic banks. We interpret this shift in FF borrowing activity as being reflective of increased liquidity needs from the domestic banking sector with reduced profitability of IOER-FF arbitrage activity from the foreign banking community (Table 3).

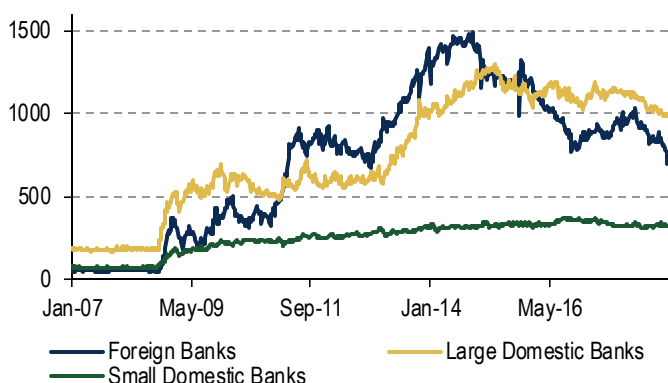
Table 3: Borrowers in the fed funds market

Type	Motivation	Constraints	Level
Foreign banks	Arbitrage profits	FF-IOER spread	Below IOER
Domestic banks	Liquidity needs	FDIC insurance, SLR	Above IOER

Source: BofA Merrill Lynch Global Research

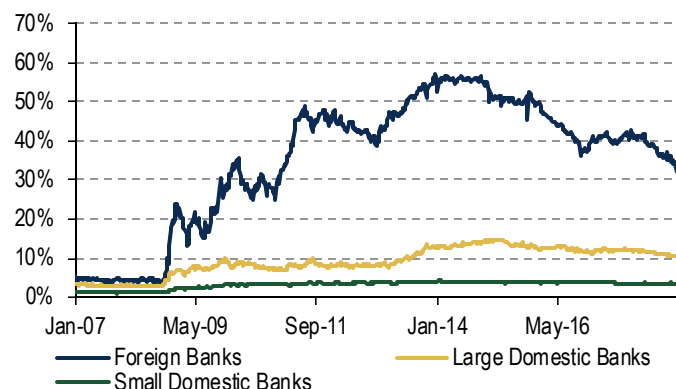
High quality foreign banks with branches in the US have been the most willing borrowers in the FF market post-crisis since they could earn the largest IOER arbitrage spread. Specifically, foreign banks could borrow from the FHLBs in the FF market or from a wider set of lenders in the Eurodollar market below IOER and then place this cash at the Fed to earn a risk free rate of return. Foreign banks find this activity more profitable vs domestic banks since they are not subject to (1) FDIC insurance fees or supplemental [capital charges](#), as their deposit base is primarily corporate / institutional clients that are not protected by the FDIC guarantee, (2) Fed leverage ratio requirements, since foreign bank branches operating in the US need only to be compliant with the less stringent leverage ratio rules stipulated by their home country regulator. The less stringent regulatory treatment for foreign banks allowed them to more profitably engage in the IOER-FF trade and this resulted in them accumulating a more sizeable share of reserves held at the Fed vs their large domestic counterparts, especially in relation to their total assets (Chart 15, Chart 16). As the IOER-FF spread has narrowed, the attractiveness of foreign bank arbitrage activity has waned and their cash holdings have declined. This activity should continue as the EFR moves closer to, and eventually above, IOER.

Chart 15: Cash assets (\$bn)



Note: cash assets include vault cash, cash items in process of collection, balances due from depository institutions, and balances due from Federal Reserve Banks.; Source: Federal Reserve, BofA Merrill Lynch Global Research

Chart 16: Cash/asset ratio (SA)



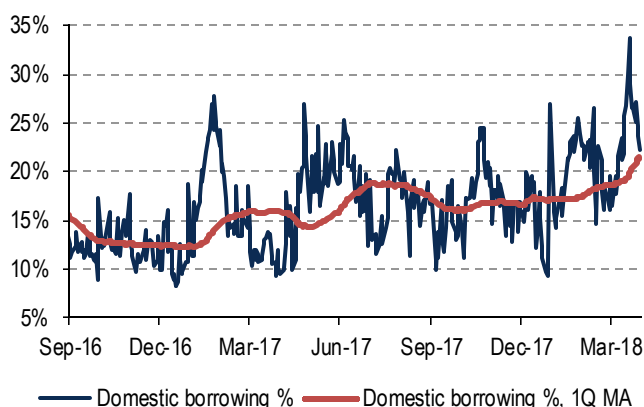
Note: cash assets include vault cash, cash items in process of collection, balances due from depository institutions, and balances due from Federal Reserve Banks.; Source: Federal Reserve, BofA Merrill Lynch Global Research

As foreign bank activity in the fed funds market has waned, domestic bank borrowing activity has increased (Chart 17, Chart 18). Domestic banks do not borrow in the FF market to earn arbitrage returns, but to access funding for either regulatory or true liquidity demand needs:

- **Regulatory / LCR purposes:** Banks that borrow from the FHLBs receive favorable regulatory treatment under the liquidity coverage ratio (LCR). Under LCR, borrowings from FHLBs have a lower outflow rate because FHLBs are not considered "financial sector entities." Our reading of LCR suggests that FHLB short term unsecured lending has at worst a 40% outflow assumption, and some interpretations of the rule may allow for an outflow rate as favorable as 25%. This means that for every \$100 borrowed from the FHLBs in FF, there is at worst a \$60 LCR benefit. For LCR constrained institutions, there are clear benefits to paying higher rates in FF with an FHLB counterparty, and the Fed has cited evidence that domestic banks are increasingly willing to do so. LCR benefits from borrowing in the FF market is the primary reason why EFR and OBR rates have recently widened, i.e. liquidity constrained banks are more

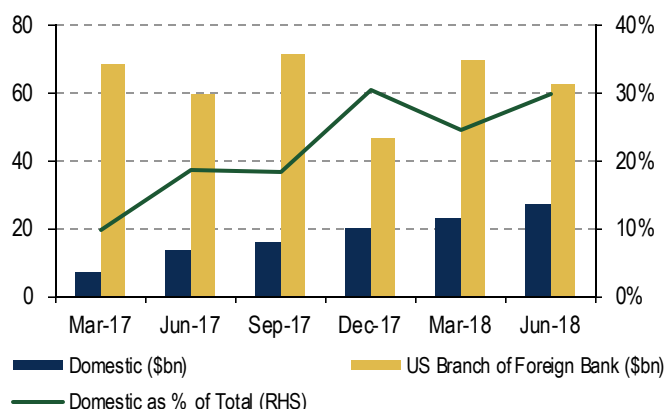
willing to pay higher rates to borrow overnight funds from the FHLBs in FF vs obtaining funding from MMF or corporates in the Eurodollar market (Chart 19).

Chart 17: Domestic bank borrowing in O/N FF has been slowly rising



Note: Data updates as of Q1 2018; Source: NY Fed, BofA Merrill Lynch Global Research

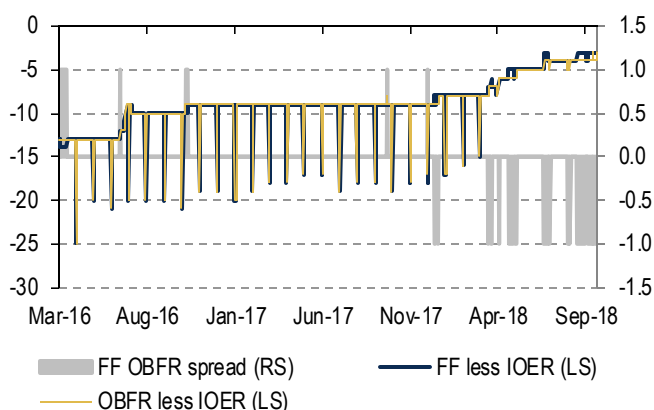
Chart 18: Unsecured overnight credit investment exposure of FHLBs



Note: unsecured credit investment exposure is comprised of federal funds sold and certificates of deposit. Source: FHLB 10K and 10Q, BofA Merrill Lynch Global Research

- Liquidity demand needs:** Domestic banks have also reportedly been more willing to borrow funds in the FF market to meet their liquidity demands. We have heard anecdotal evidence from smaller, regional US banks that are running relatively light on reserves that they use the FF market as a source of stable and relatively cheap overnight funding. These institutions report that large institutional depositor cash outflows result in them needing to replace these liabilities with other forms of readily available and inexpensive funding, such as funding through the FF market. While we cannot quantify the extent of this liquidity or “reserve scarce” demand, we do see evidence that the FHLBs are increasingly lending to lower quality domestic banks which may reflect some of this dynamic (Chart 20).

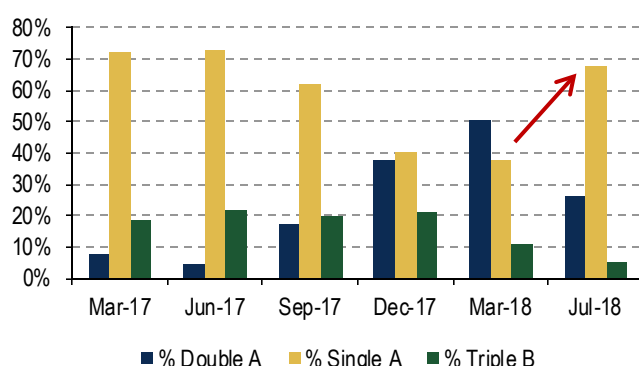
Chart 19: EFFR and OBFR rates have recently widened



Source: Bloomberg, BofA Merrill Lynch Global Research

Chart 20: Total domestic credit exposure by rating (%)

Includes both overnight and term credit exposure, majority is overnight



Source: FHLB 10K and 10Q, BofA Merrill Lynch Global Research

FHLB liquidity: sources, uses, and FF volumes

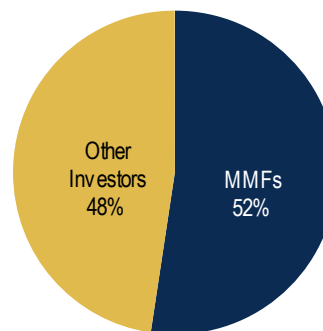
Another key element in understanding FF dynamics is the source of FHLB liquidity. FHLB debt obligations are not guaranteed by the federal government but their GSE status allows them to raise funds at very favorable rates that are only slightly above US Treasuries. The FHLBs' use of short-term funding has been [trending up for several years](#) (Chart 21) and their debt is a core part of USD government money market mutual fund investment portfolios. In fact, government money funds currently hold just over half of all outstanding debt issued by FHLBs (Chart 22).

Chart 21: FHLB short term loan issuance as % of all debt



Note: 397 eligible bonds; Source: FHLB Office of Finance, BofA Merrill Lynch Global Research

Chart 22: FHLB debt holders



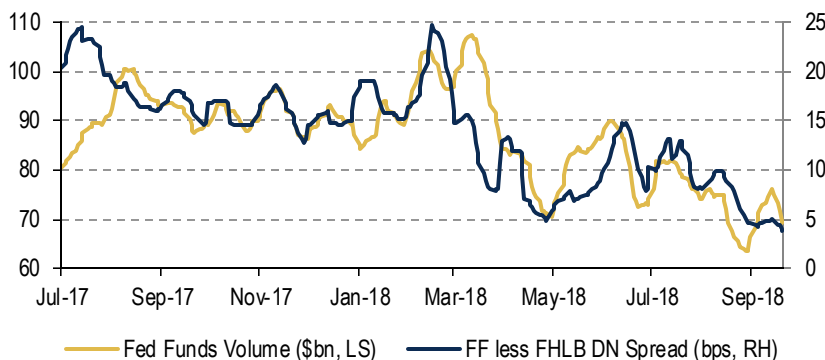
Source: FHLB Office of Finance, Crane Data, BofA Merrill Lynch Global Research

The FHLBs issue debt at a variety of tenors but rely on overnight funding as an important source of their liability mix. We believe it is reasonable to assume that FHLB overnight discount note (DN) issuance is a core funding source used to meet daily liquidity needs. When FHLB cash holdings exceed their liquidity needs, they seek to invest a portion of the remaining proceeds in the FF or other money markets. Therefore, FHLB overnight debt issuance ends up being a core source of funding for daily FF investments and contributes to overall FF market volumes.

While the FHLBs are most concerned with ensuring they have adequate cash on hand to meet their member advance needs, they are also likely cognizant of where their overnight funding costs are in relation to their overnight investment alternatives. Specifically, we believe that the FHLBs are [more likely to issue overnight DNs and invest in the FF market when the O/N DN to EFFR spread is wide](#). As the spread between the EFFR and FHLB DNs widens, the FHLBs likely issue more overnight DNs, which results in them lending more in the FF market and FF volumes increase. When the EFFR to FHLB DN spread narrows, the FHLBs are likely issue fewer overnight DNs and FF market volumes decrease. We see empirical evidence of this dynamic by examining recent trends between (1) the EFFR and FHLB overnight DN spread, and (2) FF volumes (Chart 23).

Issuing fewer DNs and lending less in the FF market when the spread is tight allows for either (1) richer DNs due to their relative scarcity (2) upward pressure on the EFFR, since the FHLBs would presumably concentrate their lower FF investments to those paying the highest rates. These adjustments are likely especially pronounced with large increases in bill supply (the most direct competition for DNs) or big drawdowns in government MMF balances, since MMF are among the largest FHLB DN investors.

Chart 23: FF to FHLB DN spread recently moves with FF volumes



Note: spread is FF less Chicago FHLB overnight DN, 10D MA; source: BofA Merrill Lynch Global Research, Bloomberg

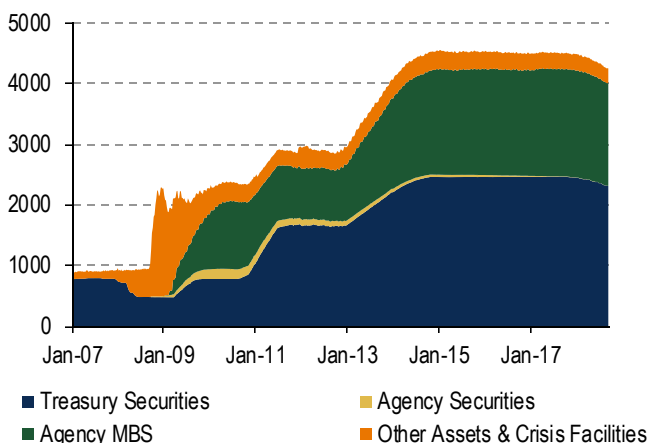
Post-crisis shift in reserves

Now that we have established how the current regime works, it is useful to review how the Fed got here. The Fed only uses their current regime because of the large increase in reserves outstanding associated with their QE programs and significant changes in the bank regulatory backdrop after the financial crisis. We provide background on the pre-crisis framework in the [appendix](#).

Fed crisis lending & QE programs resulted in an abundance of reserves

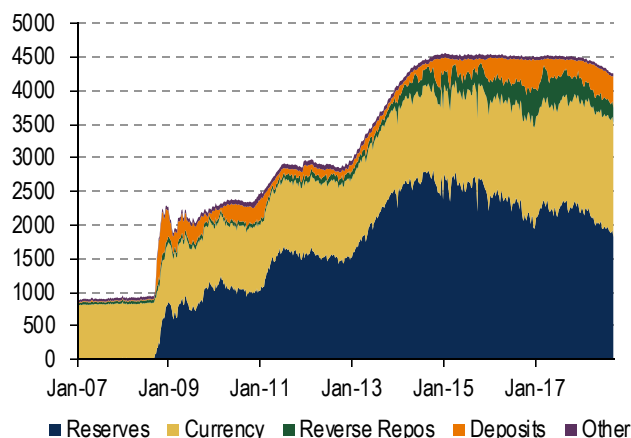
The Fed's current toolkit is only necessary because of the large amount of bank reserves in the system. This surplus of reserves came about during the financial crisis when the Fed initiated crisis lending programs and engaged in large scale asset purchase programs of Treasuries and mortgage backed securities (i.e. QE) to help ease credit conditions and stimulate the economy.

Chart 24: Assets on Fed balance sheet (\$bn)



Source: Federal Reserve, BofA Merrill Lynch Global Research

Chart 25: Liabilities on Fed balance sheet (\$bn)



Source: Federal Reserve, BofA Merrill Lynch Global Research

The Fed's balance sheet grew by \$3.6tn, from \$0.9tn to \$4.5tn, from September 2008 to December 2014 (Chart 24). The Fed's initial balance sheet expansion was driven by crisis-related credit facilities and focused on Treasury and agency MBS outright asset purchase programs in the wake of the crisis. The crisis lending and QE programs were funded through the creation of additional reserves in the banking system (Chart 25). This resulted in an increase of excess reserves from \$2bn in Jan 2007 to \$2.5tn in December 2014 (Chart 1). Similarly, as the Fed has been shrinking its balance sheet, every dollar of Treasury or agency MBS securities that has matured has resulted in a similar sized decline in the amount of reserves.

Table 4: Change in assets on Fed balance sheet

	Balance Sheet Expansion			Balance Sheet Unwind		
	1/10/2007	12/31/2014	Δ	10/4/2017	9/19/2018	Δ
Assets	887	4541	3654	4507	4256	(251)
Reserve Bank Credit	815	4458	3642	4421	4169	(252)
Securities Held Outright	779	4237	3458	4240	4011	(230)
US Treasury Securities	779	2461	1682	2465	2313	(152)
Federal Agency Debt	0	39	39	7	2	(4)
Mortgage-Backed Securities	0	1737	1737	1768	1695	(73)
Central Bank Liquidity Swaps	0	2	2	4	0	(4)
Other Federal Reserve Assets	10	30	19	27	26	(2)
Foreign Currency Denominated Assets	20	21	1	21	21	(0)
Other	78	251	173	215	199	(16)

Source: BofA Merrill Lynch Global Research, Federal Reserve

Table 5: Change in liabilities on Fed balance sheet

	Balance Sheet Expansion			Balance Sheet Unwind		
	1/10/2007	12/31/2014	Δ	10/4/2017	9/19/2018	Δ
Liabilities	887	4541	3654	4507	4256	(251)
Currency in Circulation	810	1343	533	1583	1686	103
Reverse Repurchase Agreements	29	510	481	409	234	(175)
Foreign RRP Pool	29	113	84	231	225	(5)
ON RRP	0	397	397	179	9	(170)
Deposits, ex Reserve Balances	12	249	237	239	469	230
US Treasury, General Account	5	223	218	155	400	245
Other	7	26	18	84	69	(15)
Other Liabilities & Capital	33	62	29	48	44	(3)
Reserve Balances	3	2378	2375	2229	1823	(406)

Source: BofA Merrill Lynch Global Research, Federal Reserve

Reserves increase concentrated at foreign & large domestic banks

The increase in reserves in the wake of the financial crisis was most concentrated in both (1) foreign banks operating in the US, and (2) large domestic banks. According to weekly Federal Reserve H.8 data, foreign banks operating in the US had their cash holdings increase \$1.1tn from the start of 2007 to end of 2014, while large domestic banks saw their cash holdings increase \$1.0tn over the same time horizon (Chart 15). The growth of foreign bank cash is even more pronounced when taken into consideration of their total asset sizes: the cash / asset ratio of foreign banks increased almost 10 times from the start of 2007 to end of 2014 while the cash / asset ratio of large domestic banks increased a more modest four times over the same period (Chart 16). We discuss drivers of growth from each segment:

- **Foreign banks operating (FBOs) in the US:** we believe the large increase in FBO reserve holdings has largely been opportunistic in nature since they are better able to engage in IOER arbitrage. FBOs in the US generally do not face FDIC assessments and face easier leverage ratio requirements from their home-country regulators, which made IOER arbitrage more profitable vs domestic institutions. Note that FBOs can source their funding from the FF, Eurodollar, or short-term CP / CD markets to engage in this arbitrage activity.

The FBOs with the largest reserve holdings as a percentage of their assets also tend to be those with the highest credit ratings, which allow them to most profitably engage in IOER arbitrage (Table 6). We do not believe that lower rated FBOs in the US are holding elevated reserves with the Fed for arbitrage but instead are holding them for liquidity management or regulatory purposes.

Table 6: Sample of FBOs with large cash balances & high cash / asset ratios

	Moody's		S&P		Fitch		Borrowing Rate	Reserve Cash/asset	
	ST	LT	ST	LT	ST	LT		holdings	ratio
DNB	P-1	Aa1					1.89%	23	96%
DZ	P-1	Aa1	A-1+	AA-	F1+	AA-	1.90%	8	44%
TD	P-1	Aa1	A-1+	AA-	F1+	AA-	1.90%	9	32%
Svenska	P-1	Aa2	A-1+	AA-	F1+	AA	1.91%	19	38%
Swedbank	P-1	Aa2	A-1+	AA-	F1+	AA-	1.90%	12	44%
Skandinaviska	P-1	Aa2	A-1	A+	F1+	AA-	1.90%	16	79%
Nordea	P-1	Aa3	A-1+	AA-	F1+	AA-	1.89%	26	60%
ANZ	P-1	Aa3	A-1+	AA-	F1+	AA-	1.90%	10	32%
China									
Construction	P-1	(P)A1	A-1	A	F1	A	1.93%	12	63%
ICBC	P-1	A1	A-1	A	F1	A	1.93%	15	47%
Barclays	P-1	A2	A-1	A	F1	A*+	1.95%	36	65%

Fed IOER rate

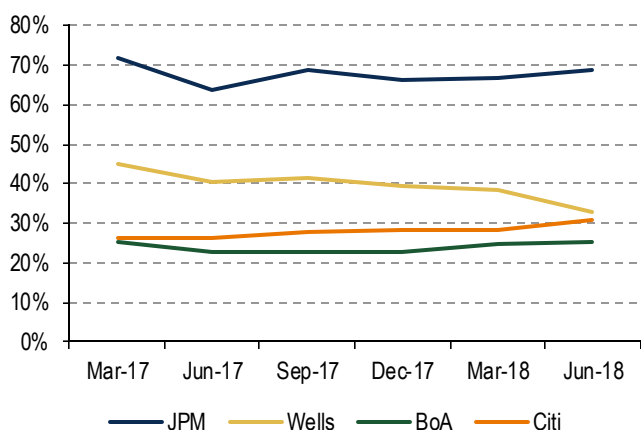
1.95%

Note: borrowing rate is taken as a weighted average of O/N time deposits from MMF reflected in the Crane data; Source: Crane Data as of end July, FFIEC, Bloomberg, BofA Merrill Lynch Global Research

- Large domestic banks: also increased their reserve holdings, but this was most likely driven by regulatory considerations. Large domestic banks needed to become compliant with new regulations imposed by the Fed, such as the liquidity coverage ratio (LCR), and appeared to have increased their cash holdings as these new rules came into effect. For example, the Basel LCR rule was proposed in January 2013 and banks likely recognized they would need to hold more cash as a result, which corresponds to the increase in large domestic bank cash and their cash / asset ratios amidst QE3 (Chart 15, Chart 16).

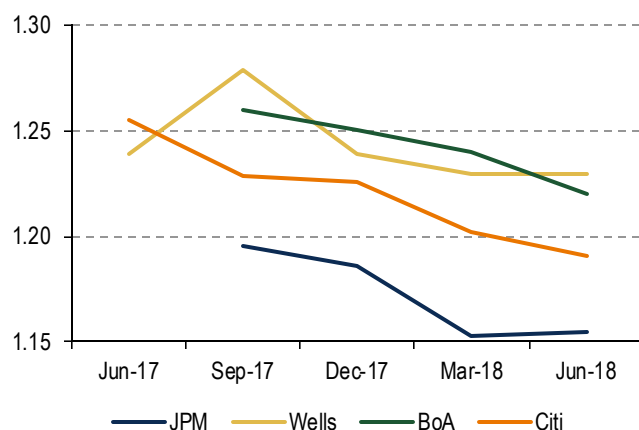
Most of the reserve holdings from domestic banks are concentrated at top banks including JP Morgan, Bank of America, Citigroup, Wells Fargo and Goldman Sachs. These five banks hold just over 60% of domestically held reserves. Certain institutions have also been deemed to be global systemically important banking institutions (GSIBs), which subjects them to greater regulatory scrutiny as well as more stringent capital and liquidity standards. The eight US GSIBs collectively hold about 70% of domestic reserves. While the cash holdings at these largest domestic banks have been decreasing with their LCRs over recent quarters, we expect that these firms will likely be less willing to see lower cash holdings in the future to meet their various regulatory requirements (Chart 26, Chart 27).

Chart 26: Cash as % of total LCR assets



Source: Company 10K and 10Qs, BofA Merrill Lynch Global Research

Chart 27: LCR ratios trending lower



Source: Company 10K and 10Qs, BofA Merrill Lynch Global Research

Reserve reduction most likely from FBOs...

As the Fed shrinks its balance sheet, we continue to believe that the largest concentration of reserve reduction will come from FBOs. FBOs that engage in IOER arbitrage activity will gradually cease it as money market rates rise and they find this to be less profitable. As this occurs, we expect that FBOs will either allow their balance sheets to shrink or they will replace their assets with other higher yielding alternatives. Fed H.8 data shows that as the Fed started shrinking its balance sheet, foreign banks have shrunk their balance sheets only modestly and offset lower cash holdings with repo, Treasuries, and mortgage assets (Table 7).

... less likely from large domestics

Large domestic banks will likely be more reluctant to see their reserve holdings decline, but the ongoing Fed balance sheet shrinkage may ultimately force them to hold other forms of high quality liquid assets (HQLA). We expect that large domestic banks would be most willing to see their reserve holdings decline only as the price of reserve substitutes, such as overnight GC repo, cheapens meaningfully above IOER.

Large domestic banks have demonstrated a strong desire to hold reserves as their preferred means to meet regulatory requirements. Reserves are reportedly the preferred

means for banks to meet their LCR HQLA requirements, intraday and seasonal liquidity demands, and their living will / resolution needs.

Table 7: Bank assets and liabilities during balance sheet unwind (\$bn, NSA)

		Assets							Liabilities				
		Total Assets	Cash	Treasuries	MBS	Repo	Loans & Leases	Other	Total Liabilities	Deposits	Borrowings	Net due to foreign offices	Other
All Banks	10/4/2017	16512	2365	695	1785	434	9044	2190	16512	11951	1999	167	2395
	9/12/2018	16784	2085	734	1819	560	9407	2179	16784	12251	1965	98	2470
	Δ	272	-279	39	34	126	362	-11	272	300	-34	-69	75
	%Δ	2%	-12%	6%	2%	29%	4%	-1%	2%	3%	-2%	-41%	3%
Domestic Banks	10/4/2017	14236	1421	600	1772	151	8329	1964	14236	10907	1088	-37	2279
	9/12/2018	14572	1363	605	1796	178	8690	1940	14572	11262	1092	-115	2333
	Δ	336	-57	6	23	27	361	-24	336	355	4	(77)	54
	%Δ	2%	-4%	1%	1%	18%	4%	-1%	2%	3%	0%	206%	2%
Foreign Banks	10/4/2017	2276	944	96	12	283	715	226	2276	1044	911	205	116
	9/12/2018	2212	722	129	23	382	717	239	2212	989	873	213	137
	Δ	-64	-222	34	11	99	2	13	(64)	(55)	(38)	8	21
	%Δ	-3%	-24%	35%	85%	35%	0%	6%	-3%	-5%	-4%	4%	18%

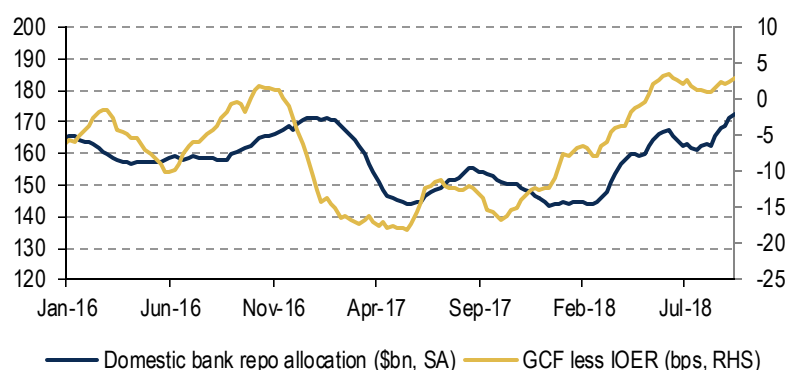
Note: the Fed's balance sheet unwind started in October 2017; we use data from Oct 4 '17 in order to avoid any quarter-end window dressing. Red indicates areas of notable decrease. Source: Federal Reserve, BofA Merrill Lynch Global Research

Banks likely prefer to hold reserves as their preferred form of HQLA since they are:

- (1) accessible intraday at any point until Fedwire closes at 6:30 PM
- (2) not subject to transaction costs
- (3) looked upon favorably from a regulatory perspective
- (4) attractive from a return perspective, especially vs short-dated USTs

Given that reserves held at the Fed are viewed as a relatively special form of HQLA, banks will likely require incentive to shift out of this preferred habitat. To shift out of reserves and into the closest HQLA substitute of overnight Treasury GC repo, banks have informed us that they would generally require a sustained spread pickup of 10-15 bps above IOER. Banks would also likely want to ensure that this degree of repo cheapness would be stable since bank portfolios reportedly prefer not to make frequent and sizeable changes in their HQLA allocations.

Chart 28: Banks need to see more of a sustained yield increase to invest in repo



Note: 3m moving average; Source: Federal Reserve, BofA Merrill Lynch Global Research

There is some evidence that banks will modestly increase their repo allocation as GC cheapens vs IOER, but it will likely require a greater extent of cheapening to see banks move a sizeable portion of their reserve holdings into repo or USTs (Chart 28). Since the Fed started its balance sheet reduction, domestic banks have only slightly reduced their cash allocations and only modestly increased their holdings of USTs, MBS, or repo.

Desire to hold reserves & their concentration = pressure on unsecured funding

While the Fed controls the amount of reserves in the US financial system, banks set their price. We believe the price of reserves evidenced through the FF market may rise faster than the market anticipates due to (1) large bank reluctance to see their reserve holdings decline, and (2) the high concentration of reserve holdings at the largest domestic commercial banks.

As the Fed drains reserves and the cost of unsecured funding continues to rise, we do not expect banks to be enthusiastic lenders of their reserves even after FF rises above IOER. Theoretically, banks should be willing to lend their reserve holdings as soon as FF exceeds IOER since they could earn a better return by doing so. However, post crisis regulatory rules discourage banks from reducing their reserve holdings and engaging in unsecured interbank lending activity. Interbank loans may negatively impact credit and risk weighted asset exposures, leverage and FDIC charges, HQLA portfolios, and GSIB "interconnectedness". We do not know at what rates banks would lend in the FF market but have heard anecdotally it would require at least upwards of IOER +30-50bps (i.e., near the discount window). A number of banks have also suggested they would require even larger returns to lend in the FF market, with a few banks indicating that there is no spread level at which they would consider lending reserves in the FF market.

Large domestic banks' reluctance to lend coupled with the current high concentration of reserves will likely increase pressure on unsecured funding costs over time. This will likely be true even as the amount of reserves remains quite large, since the largest reserve holders are reluctant to lend them. The Fed also shares concerns about the acceleration of unsecured funding pressures in a highly concentrated reserve environment: a recent Fed paper noted that, "if reserves are highly concentrated and the largest banks hoard balances, the EFFR drifts above the IOER rate earlier".⁷ (Exhibit 3)

Exhibit 3: FRBNY diagram on reserves and EFFR

The Level of Reserves at which the Effective Fed Funds Rate Tops IOR Depends on the Concentration of Reserves

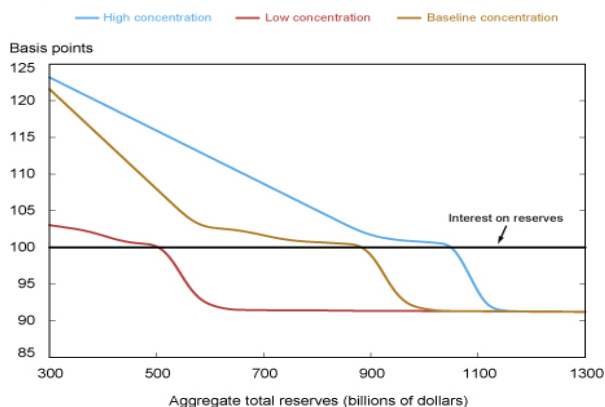
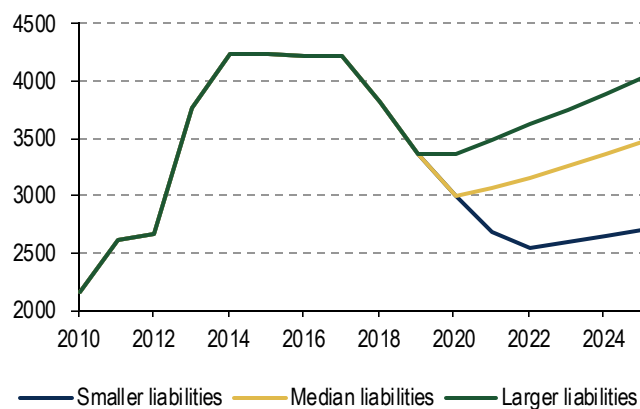


Chart 29: Dealer & buy-side expectations for Fed B/S evolution (\$bn)



Pressure on unsecured funding may mean an earlier stop to Fed B/S unwind

As discussed [here](#), we have long believed that further upward pressure on the EFFR may not allow the Fed to continue its balance sheet reduction for as long as many in the market have expected. Responses to Fed surveys have indicated that the "median liability" scenario will see the balance sheet unwind through 2020, with some expecting the unwind to last through 2022 (Chart 29). [We believe](#) the end date could be as soon as the end of 2019. However, neither we nor the Fed know exactly how far reserves would need to fall before unsecured funding conditions show broader signs of reserve scarcity.

⁷ See Afonso et al., "Size Is Not All: Distribution of Bank Reserves and Fed Funds Dynamics", <http://libertystreeteconomics.newyorkfed.org/2018/07/size-is-not-all-distribution-of-bank-reserves-and-fed-funds-dynamics.html>

We have [previously estimated](#) that banks will not want to see their reserve holdings fall below \$1tn, and this number seems consistent with recent Fed studies. We arrived at \$1tn by (1) estimating "excess HQLA" from the four large domestic money center banks with a minimum 110% LCR; (2) assuming the rest of the domestic banking sector has a similar proportion of excess HQLA that could be drawn down; and (3) adjusting foreign bank cash/asset ratios lower such that they are equivalent to growth in their domestic bank counterparts since 2007. Recent Fed studies have also indicated that FF will trade above IOER once reserves fall to \$800bn-\$1tn but could happen at levels of closer to \$1.1tn if reserve holdings remain highly concentrated.⁸ If we are right that the US financial system will require close to \$1tn in reserves, this implies that the Fed's balance sheet unwind might need to end towards the end of 2019 or early 2020, with risks that it could happen sooner (Table 8).

Table 8: Fed balance sheet unwind may have to cease by end 2019 (\$bn)

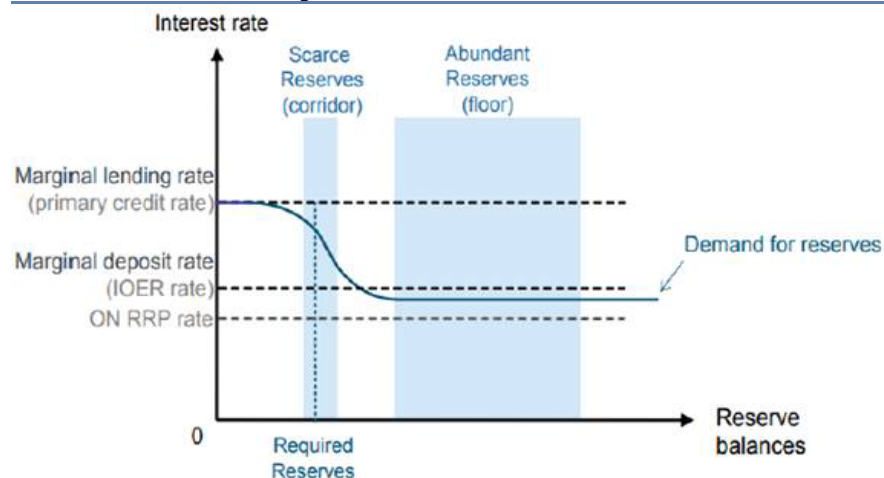
		End '17	Current	End '18	End '19	End '20
Assets	Treasuries	2454	2313	2225	1954	1758
	Agency MBS	1765	1695	1625	1485	1358
	Other	277	247	242	232	222
	Total Assets	4496	4256	4093	3672	3338
Liabilities	Currency	1616	1686	1728	1848	1975
	Deposits	269	469	430	450	470
	Fed Repo	387	234	255	270	280
	Other	48	44	47	50	52
	Reserves	2176	1823	1632	1054	561
	Total Liabilities	4496	4256	4093	3672	3338

Note: shaded region indicates estimates; source: BofA Merrill Lynch Global Research, Federal Reserve

Fed policy framework choices

The potential for an earlier tightening in unsecured funding conditions should force the Fed to address their preferences around the monetary policy framework over coming months. We expect this discussion to kick off soon, and believe that the upcoming speech from NY Fed President Williams on September 28th should offer some initial thoughts in this regard.

Exhibit 4: Corridor and floor regimes



Source: NY Fed

The Fed essentially has [two options for its monetary policy framework](#): return to a pre-crisis reserve scarce **corridor system** or maintain its current reserve abundant **floor system**, which are shown below (Exhibit 4, Table 9). Note that the reserve demand curve in Exhibit 4 should be thought of as the demand curve for FF.

⁸ See Afonso et al, "Size Is Not All: Distribution of Bank Reserves and Fed Funds Dynamics",

Corridor and floor regimes

Floor (abundant reserve) framework

This is the current monetary policy regime, which is represented on the right side in Exhibit 4. It is characterized by the central bank providing an abundance of reserves such that large swings in existing balances (typically due to fluctuations in other Fed liabilities) do not materially influence the demand for reserves or the interest rate at which they are traded.

Current application of this regime requires the Fed to maintain a relatively large balance sheet to ensure an adequate provisioning of reserves. It also requires the Fed to rely on both IOER and ON RRP as key parts of their operating framework. IOER serves as the magnet that pulls or pushes other money markets higher or lower, while ON RRP functions as a relatively solid money market floor that allows the Fed to raise rates even with abundant reserves. Given the abundance of reserves in the system, banks generally do not need to borrow to meet their minimum reserve or regulatory requirements. Note that the discount window is still present as a backstop lending facility of last resort.

If reserve demand were to increase and approach the upward sloping part of the demand curve, the Fed would utilize reserve adding open market operations sufficient to meet this increase in demand. If the Fed sticks with a floor regime, some Fed officials have argued in the past for a buffer of ~\$150 bn in reserves above where true reserve demand is expected to emerge to keep the EFFR low and within the Fed's target range.⁹ If the Fed decides to preserve a floor system, it would likely mean an earlier end to the balance sheet unwind and [less Treasury supply in the open market](#) which should richen Treasuries vs EFFR expectations.

Table 9: Key differences of floor vs corridor policy regimes

	Floor	Corridor
Fed funds vs IOER	FF near IOER	FF meaningfully above IOER
Historical Comparison	Current system	Pre-crisis system
Pros	Existing system working well	Similar to more traditional Fed regime
	Easy to implement & communicate	Smaller relative balance sheet size
	Does not require frequent or large open market operations	Less political criticism (i.e. Fed market footprint, IOER as bank subsidy)
	Ensures reserves plentiful for bank regulatory requirements	
Cons	Larger relative balance sheet size	Operationally challenging
	More potential political criticism	Fed funds market not particularly robust

Source: BofA Merrill Lynch Global Research

Corridor (scarce reserve) framework

This was the pre-crisis approach to monetary policy, which is represented on the left side of Exhibit 4. It relies on a scarcity of reserves where relatively small swings in reserves outstanding can have a meaningful impact on the demand for reserves and the interest rate at which they are traded.

Application of this regime would require that the Fed further reduce the amount of reserves outstanding to levels at which there is true "scarcity". We believe the Fed defines "scarcity" as observing a more direct relationship between the amount of reserves in the system and the interest rate at which these reserves are traded, i.e. when a relatively small amount of reserves is drained it would result in clear upward pressure on the reserve demand curve and vice versa.

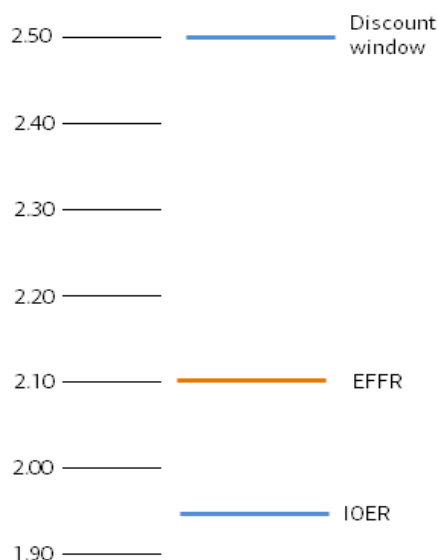
This regime would also require the Fed to conduct frequent open market operations to add or drain reserves sufficient to hit the target EFFR. If the Fed returned to this framework, fed funds would trade between IOER and the discount window, and this

⁹ <https://www.newyorkfed.org/newsevents/speeches/2017/log170518>

would become the new target range for the EFFR (Exhibit 5). Banks would only maintain reserve holdings at IOER to meet their minimum reserve or other regulatory requirements. The discount window rate would continue to act as a ceiling because banks should not be willing to borrow at a rate higher than what they would pay to borrow from the Fed (stigma considerations aside). It is unclear whether the Fed would need to maintain the ON RRP in a scarce reserve regime because money market rates would generally be expected to trade above IOER.¹⁰

If the Fed decides to return to a corridor regime, we expect EFFR would trade above Treasury GC repo due to increased competition for reserves and the inherent credit risk in unsecured bank lending. We expect banks would be reluctant lenders in the FF market and bank portfolios would be much more willing to reallocate their reserves into Treasury GC repo or short dated Treasury securities. As a result, we would expect Treasuries to richen vs EFFR expectations.

Exhibit 5: Hypothetical corridor regime



Source: BofA Merrill Lynch Global Research

Future expectations & considerations

The Fed has provided limited guidance on its preferred monetary policy framework in recent months, but prior comments Fed officials have provided appear to lean towards a floor system. In June 2017, Fed Chair Powell commented that:

“Some have advocated a return to a framework similar to the pre-2007 system ... This “corridor” framework remains a feasible option, although, in my view, it may be less robust over time than a floor system.”

Comments like these lead us to suspect the Fed may be [leaning towards maintaining a floor system](#) instead of a corridor system for their longer-run policy framework. We believe the Fed sees the floor system as working well at present, easy to implement, not requiring frequent open market operations, and ensuring plentiful reserves for the banking system to meet regulatory requirements. However, a floor system would expose the Fed to greater political and market criticism from maintaining a larger balance sheet. We expect the Fed will be able to make a strong case for why they remain with a relatively large balance sheet, though there will be communications challenges.

¹⁰ ON RRP could be maintained in a corridor regime if the Fed wanted to provide MMF an investment backstop around quarter end dates. This could limit downward pressure on money market rates around key balance sheet reporting dates.

As the Fed revisits its monetary policy framework, we also believe they may look to revise their policy target and [incorporate SOFR more directly into their policy setting](#) over coming years. As we discussed earlier in this primer, EFFR activity is dominated by the FHLBs, has limited volumes, and is not broadly representative of interbank lending activity. SOFR, on the other hand, has deeper volumes, a wider set of market participants, and has proven robust to regulatory changes. Any shift toward SOFR as the policy target would improve the Fed's monetary policy transmission, especially since [SOFR is slated to replace LIBOR](#) as the primary US benchmark for financial contracts. However, we expect that the Fed might first need to decide on their longer-run policy framework before more directly incorporating SOFR into their policy setting approach.

Appendix – pre crisis regime

Before the financial crisis, the Fed relied on a corridor regime based on reserve scarcity. The FOMC set a specific target level for the EFFR and used open market operations (OMOs) to achieve this rate. Reserves were scarce and domestic banks borrowed and lent in the FF market to fulfil their reserve requirements. The FOMC used OMOs, the buying and selling of government securities, to control the supply of reserves that influenced the rate at which banks borrowed or lent to each other. For example, OMOs that relied on repo operations involved a temporary purchase of government securities that was funded by increasing reserves; this increase in reserves typically led to a lower fed funds rate. In contrast, engaging in reverse repo operations involved selling securities which reduced reserves and led to increases in the fed funds rate.

Before the financial crisis the Fed's balance sheet size and the amount of reserves in the system were relatively small. Thus, open market operations could have a substantial impact on reserve demand and the fed funds rate. There was also no IOER tool that the Fed could use in order to help them set policy.

Exhibit 6: Demand and supply of federal reserve balances

Demand	Supply
Required reserves	Fed's portfolio
Clearing balances	Discount window
Excess reserves	Liabilities (autonomous factors)

Source: NY Fed, BofA Merrill Lynch Global Research

In order to determine the correct amount of securities to buy/sell to achieve the fed funds target, the NY open market trading desk had to forecast supply of and demand for reserves¹¹ (Exhibit 6). Reserve demand came from banks that needed to meet their reserve requirements, desired to hold slightly elevated reserves for general liquidity purposes, or wanted reserves for their clearing balances. Pre-crisis banks did not face as stringent liquidity requirements as they do today and did not earn IOER, which meant that banks generally did not desire holding reserve balances above their minimum requirements. This made it easier for the Fed's open market desk to forecast the amount of reserve balances needed to be added or drained to achieve their target.

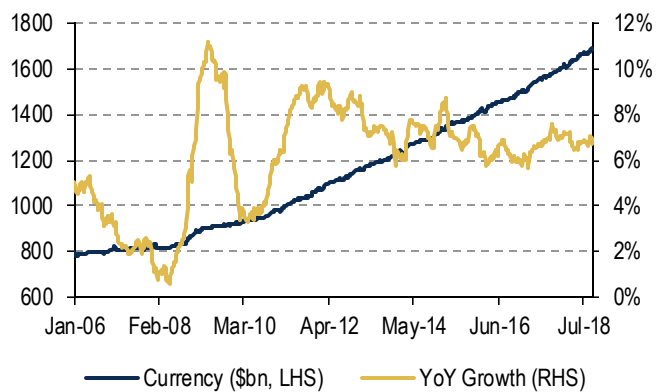
In determining the proper amount of reserves to add or drain in order to hit their target federal funds rate the Fed's open market desk also had to forecast a number of different factors that could influence the supply of reserves. Outside of the reserve requirements and discount window activity, the most challenging factors for the Fed to forecast were "autonomous factors" that included: currency in circulation, the Treasury general account, and the foreign repo pool.

¹¹https://www.newyorkfed.org/medialibrary/media/research/staff_reports/sr809.pdf?la=en

- **Currency** – Currency in circulation is the largest autonomous factor. When a bank withdraws currency from the Fed, it is funded using the bank's reserves. Thus, as demand for currency increases, reserves decline. In order for the Fed to maintain a stable amount of reserves in the system, it needs to offset this currency growth by buying assets (traditionally US Treasuries) and increasing reserves outstanding. Currency in circulation typically follows seasonal and long term trends, and has been steadily increasing since 2008, growing on average at 6.7% / year (Chart 30).
- **Treasury general account (TGA)** – the TGA is essentially the checking account for the US Treasury and is used for federal spending. The amount of cash in the Treasury's bank account is reflected through the cash balance. Prior to the crisis, the Treasury's cash balance was relatively small and stable (Chart 31). During the crisis and more recently since 2016, Treasury's cash balance levels have increased substantially. Treasury now maintains a minimum cash balance of \$150 bn but typically prefers to hold sufficient cash balances to meet five days of potential outflows. Treasury's cash balance can also vary widely with debt limit dynamics, which has made it more challenging to forecast over recent years. An increase in Treasury's cash balance drains reserves from the system (since Treasury is raising cash that it deposits at the Fed) and a decrease in the cash balance adds reserves to the system. To maintain a stable amount of reserves, the Fed would need to offset cash balance increases by adding reserves or sterilize cash balance decreases by draining reserves.
- **Foreign repo pool** – Certain foreign banks and official institutions have custodial accounts with the NY Fed and can invest overnight funds in repo directly with the Fed (Chart 31). Foreign central bank investments with the Fed impact reserve balances similar to the TGA: an increase in foreign repo investments with the Fed drains reserves, while a decrease in this activity increases reserves. Pre-crisis, the Fed's open market desk would have to sterilize variations in the foreign repo pool with OMOs. This led to the Fed imposing tight limits on customers' ability to vary the size of their overnight repo investments. However, post crisis, the Fed removed some the constraints imposed on their customers' ability to use the repo pool since reserves are abundant and some central banks that desire to hold large liquidity buffers were discouraged from keeping them at private sector banks.

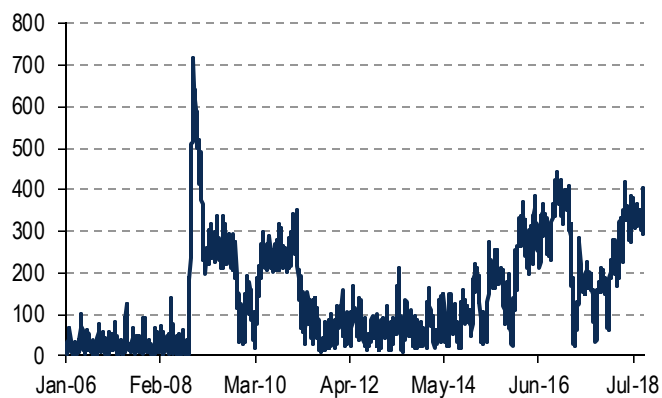
Overall, the Fed's pre-crisis regime relied on reserve scarcity and the Fed needed to add or drain the appropriate amount of reserves in order to hit their fed funds target rate. This regime relied on the Fed accurately forecasting supply & demand of reserves that were influenced by private bank required reserve and liquidity needs as well as other "autonomous factors". If the Fed chooses to move back to their pre-crisis monetary policy operating framework they will again need to accurately forecast bank reserve demand and other "autonomous factor" changes. This would likely be more challenging vs the pre-crisis regime because of bank regulatory changes and "autonomous factors" that have become larger and more volatile.

Chart 30: Currency in circulation



Source: Federal Reserve, BofA Merrill Lynch Global Research

Chart 31: Treasury cash balance (\$bn)



Source: US Treasury, BofA Merrill Lynch Global Research

Chart 32: Reverse repo, foreign official and international accounts (\$bn)



Source: Federal Reserve, BofA Merrill Lynch Global Research

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