

October 19, 2018

Recent Developments in Reserve Markets and Understanding Reserve Demand¹

Overview of recent developments

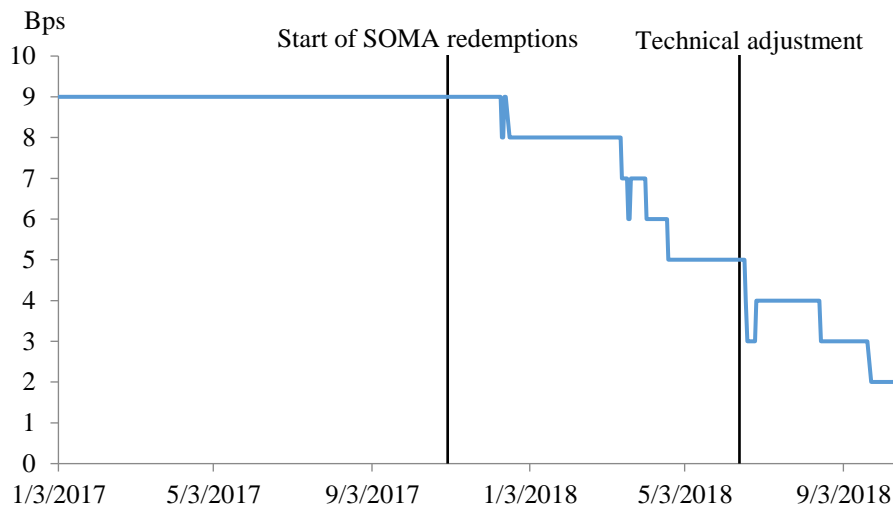
The spread between the interest rate on excess reserves (IOER) and the effective federal funds rate (EFFR) has narrowed seven basis points since the beginning of 2018 (Figure 1) and now stands at one basis point. This narrowing occurred against a backdrop of declining reserves due to System Open Market Account (SOMA) portfolio redemptions and growth in currency. While the decreasing spread, in conjunction with diminishing reserves, could be perceived as a potential marker of increasing competition among banks to retain reserve balances, staff analysis suggests that several other factors unrelated to such reserve competition appear to explain these dynamics. The most important driver was upward pressure on secured financing rates (notably general collateral repo) stemming from an increase in the supply of Treasury securities, and the spillover from repo to other money markets then shifted the constellation of overnight rates higher. In addition, periodic decreases in federal funds lending by Federal Home Loan Banks (FHLBs), combined with increased bank demand for funding from FHLBs because of the favorable treatment of this funding in the liquidity coverage ratio (LCR), contributed to upward pressure on the EFFR.^{2,3}

¹ Board of Governors: Sriya Anbil, Alyssa Anderson, Courtney Demartini, and Laura Lipscomb; Federal Reserve Bank of New York: Gara Afonso, John McGowan, and Will Riordan. We thank Sam Schulhofer-Wohl, Zeynep Senyuz, and Patricia Zobel for their guidance. We thank Kathryn Chen, Margaret DeBoer, James Egelhof, Josh Frost, Josh Gallin, Mike Gibson, Brian Hefferle, Ennis Huberto, Jeffrey Huther, Antoine Martin, Patrick McCabe, Ed Nosal, Julie Remache, Steve Spurry, Jon Willis and Gretchen Weinbach for their valuable comments. We also thank Reserve Bank research directors, their designees, and governors' advisors for useful suggestions.

² Some of these developments were covered in April and July 2018 FOMC memos, which also discussed the technical adjustment to IOER. The July 2018 memo provides information on FHLB liquidity requirements. For additional background on pre-crisis money market dynamics and subsequent structural changes, see "Money Markets," memo to the FOMC, July 13, 2016. Going forward, factors not directly related to normalization of the Federal Reserve's balance sheet may put further upward pressure on the EFFR. For example, Treasury issuance is expected to increase through the end of this year, but then will likely decline significantly per the Treasury Department's usual practice of managing down its cash balance towards the end of a debt limit suspension period.

³ In the United States, banks subject to the liquidity coverage ratio (LCR) are required to have sufficient high-quality liquid assets (HQLA) available to cover short-term liquidity needs (net cash outflows over a 30-day time horizon) under an acute liquidity stress scenario. Net cash outflows are calculated using a series of inflow and outflow assumptions that are based, in part, on the tenor of funding and counterparty type. For unsecured funding with maturities fewer than 30 days (e.g., overnight fed funds borrowing), the LCR applies only a 40 percent run-off assumption to loans from FHLBs, while such lending from other financial counterparties faces a 100 percent run-off

Figure 1: Spread between Interest on Excess Reserves and the Effective Federal Funds Rate⁴



Source: Bloomberg. Excludes month ends.

Identification of markers of competition to retain reserve balances and staff’s current assessment

Staff monitor a number of markers to assess whether the decline in aggregate reserves is changing bank reserve management behaviors and/or having an influence on rates (see Appendix). As reserve levels come down in aggregate, some banks could find their reserve levels falling further than desired, and would take action to maintain or increase those levels. For some banks, particularly smaller institutions, the minimum desired reserve levels reflect a need for clearing balances to facilitate payment activity or reserves to meet requirements. Larger institutions may also be motivated to hold reserves that they view as necessary to satisfy their internal liquidity stress tests or otherwise manage liquidity risk. Against this backdrop, staff are monitoring markers that would suggest increasing or more broad based need for reserves, and pressure in money markets associated with greater competition to retain reserve balances. When analyzing market dynamics, staff look at markers holistically, rather than considering markers in isolation. Detailed explanations of several key markers are provided in the Appendix. In recent months, some markers have suggested a slight increase in competition among some banks to retain reserve balances and a decline in activity associated with IOER arbitrage. First, the share

rate. Borrowings from retail and small business counterparties are also treated more favorably relative to those from financial counterparties.

⁴ At the June 2018 FOMC meeting, the Board voted to raise IOER to 1.95 percent, effective June 14, 2018. Setting this level 5 basis points below the top of the target range for the federal funds rate was intended to foster trading in the federal funds market at rates well within the FOMC’s target range.

of fed funds trading above IOER increased to 5.8 percent on average in September relative to 1.3 percent in the first quarter (Appendix figure A.1). Second, borrowing in the fed funds market by participants who have stated that their primary motivation is IOER arbitrage has decreased. As a result, borrowing for purposes of improving LCR metrics and meeting funding needs now represents more than half of the fed funds volumes.⁵

At the same time, most markers do not indicate increasing signs of reserve need among banks or pressures related to competition for reserves. In particular, use of primary credit has not increased, and daylight overdrafts remain little changed and fairly muted in 2018. In addition, there has not been a significant broadening in the number or type of banks borrowing in the fed funds market (Appendix figure A.2). On net, the recent decline in aggregate reserves has not had a direct, material impact on conditions in the fed funds market. For more information on these markers, including staff's current assessment, please see the Appendix.

Going forward, dynamics not directly related to normalization of the Fed's balance sheet, including increases in Treasury issuance, which are expected to persist given current estimates of the Treasury's borrowing needs, may put further upward pressure on the EFRR.⁶ The remainder of this memo will:

- Discuss drivers of banks' demand for reserves;
- Provide an estimate of the level of aggregate reserves at which we would expect to see *widespread* signs of banks competing for reserves;
- Highlight potential issues associated with reserves concentration.

Drivers of banks' demand for reserves

For monetary policy implementation, it is important to determine when the aggregate supply of reserves becomes scarce relative to banking system demand.⁷ This level is equal to the quantity of reserves at which the marginal benefit of acquiring the next dollar of reserves would exceed IOER for the marginal borrowing bank, in the absence of frictions that impede or prevent the efficient redistribution of reserves in the banking system. We would expect the EFRR to

⁵ Classification and tracking of bank borrowing based on motivation has been done through Desk analysis of FR2420 reporter behavior and outreach.

⁶ The Treasury Department publishes a range of net marketable borrowing estimates in its quarterly refunding presentation to the Treasury Borrowing Advisory Committee. <https://www.treasury.gov/resource-center/data-chart-center/quarterly-refunding/Pages/Latest.aspx>. Current estimates are around \$1 trillion for each of the next three fiscal years.

⁷ In the Policy Normalization Principles and Plans of June 2017, the Committee agreed that the level of reserves "will reflect the banking system's demand for reserve balances and the Committee's decisions about how to implement monetary policy most efficiently and effectively in the future."

print consistently above IOER when the supply of reserves falls to such a level, but the EFFR printing above IOER may not necessarily mean reserves are scarce.⁸ Pre-crisis, bank demand for reserves was primarily a function of reserve requirements and payment needs, and banks held only a small amount of reserves for liquidity buffers. At that time, the Federal Reserve did not pay interest on reserves, and banks demanded only a small amount of excess reserves because of the positive opportunity cost of holding balances. Banks held liquidity buffers in assets other than reserves, such as Treasury and agency securities. Post-crisis, the factors determining a bank's demand for reserves have expanded. In part reflecting shifts in regulatory and supervisory standards, banks now hold larger liquidity buffers, comprising both highly liquid securities and reserves. At the same time, the opportunity cost of holding reserves has declined due to the introduction of interest on reserves, with reserves currently earning a rate close to market rates.

The post-crisis focus on precautionary liquidity has generated greater demand for reserves and other liquid assets. For the purposes of the LCR, Treasury securities and reserves are both deemed level 1, or the highest quality, high-quality liquid assets (HQLA). To the extent that banks view these assets as close substitutes, banks should be willing to shift the composition of their HQLA toward more Treasury securities when the risk-adjusted return on these securities exceeds IOER. However, in outreach to banks, many stated that they do not view reserves and other HQLA as perfect substitutes, and pointed to factors beyond the LCR and relative return as important determinants of demand for reserves.

Insights on reserve demand from bank outreach

During 2018, staff have supplemented normal market monitoring by systematically holding conversations about reserve management practices with 12 banks, representing different sizes and business models.⁹ These dialogues revealed that banks have highly heterogeneous approaches toward reserve management. Some banks maintain reserves close to minimum clearing and payment needs, and hold the bulk of their liquidity buffers in securities. These institutions expect that their capacity to access intermittent short-term borrowing, mostly in the form of advances from FHLBs, is sufficient to cover potential payment shocks. Others hold a higher share of reserves in their liquidity portfolios due to concerns about their ability to quickly monetize large quantities of other HQLA or to access funding markets in a stress scenario. Some banks with significant volatility in daily payment flows also hold a buffer of reserves due to

⁸ Should there be frictions that limit the efficient distribution of reserves or affect pricing of overnight unsecured activity, rates could rise above IOER before this aggregate level of scarcity is reached.

⁹ From February to September 2018, the Desk conducted conversations with staff in the treasury function at 12 banks, including many of the U.S. Global Systemically Important Banks (GSIBs), foreign banks, and large regional banks. Average reserve holdings of the 12 selected banks in August 2018 were \$717 billion or 37 percent of total reserves in the banking system.

reservations about incurring daylight overdrafts, notwithstanding the Payment System Risk (PSR) policy that allows such overdrafts. For banks that view reserves and other HQLA as imperfect substitutes due to payment or liquidity needs, reserve demand is likely to be less sensitive to the spread between IOER and the return on other HQLA.

Insights on reserve demand from a recent bank survey

To obtain greater insight into the determinants of banks' reserve demand, staff distributed the Senior Financial Officer Survey (SFOS) in August 2018. The survey gathered information from 51 domestic and foreign banks with a range of asset sizes and business models.¹⁰ These institutions held roughly \$1.3 trillion of the \$1.9 trillion reserve balances in the banking system as of August 2018.¹¹

Most banks currently hold reserve balances in excess of the lowest level they might demand at current rates. To better understand banks' demand for reserves, the SFOS asked respondents to identify the approximate lowest level of reserve balances that their institutions would feel comfortable holding before taking actions to maintain or increase reserves, given the current configuration of interest rates. The sum of the respondents' reported lowest comfortable balances is about \$615 billion, which is nearly half of these respondents' total current balances. Within the panel, there were variations in responses that staff could not readily associate with observable bank characteristics. This heterogeneity may reflect differences in bank business models that are not directly observable, as well as different perceptions of the substitutability of reserves and other HQLA. There was also wide variation in the difference between banks' lowest comfortable balances and their current holdings. Some banks reported that they were already holding balances near their lowest comfortable levels while others reported having balances far above their lowest comfortable levels.

Staff used a range of methods to estimate the banking system's total lowest comfortable level of reserve balances in the current rate environment. Various calculations produced similar estimates.¹² The baseline estimation approach focused on summing the reported answers and estimating the remaining population by assuming the sample population's ratio of lowest

¹⁰ For the purposes of analyzing survey responses, staff grouped each of the survey respondents into one of four groups: U.S. GSIBs, domestic banks with assets greater than \$50 billion that are not GSIBs, domestic banks with assets less than or equal to \$50 billion, and foreign banks.

¹¹ The SFOS panel included all of the U.S. GSIBs. In aggregate, GSIBs held about \$750 billion of reserves.

¹² The grossed-up estimates for the entire system can be compared against estimates in the March 3, 2017, FOMC memo titled "Changing the FOMC's Reinvestment Policy: Approaches and Considerations." That memo outlined five approaches to estimate reserve demand and the total balances necessary to operate a floor system. Aside from a very low estimate based on bank payments activity, the estimates ranged from \$600 billion to \$1 trillion.

comfortable reserves to total assets applied to the non-reporting institutions by bank category. This method resulted in a point estimate of \$822 billion.

One source of uncertainty in this point estimate is that banks not in the sample might behave differently than assumed. In addition, banks themselves were uncertain about their minimum levels of demand and might ultimately behave differently than they reported in the survey. As a result, the point estimate could either overestimate or underestimate the minimum quantity of reserves that banks would actually want to hold in the current rate environment. We therefore created low and high scenarios to “book-end” the \$822 billion estimate. To create these scenarios, we assumed that, within each group, banks at the 25th and 75th percentile of survey responses for the ratio of lowest comfortable balances to assets may be representative of how all banks in that group will ultimately behave in general.¹³ The resulting low-end estimate is \$500 billion, and the high-end estimate is \$1.3 trillion.¹⁴

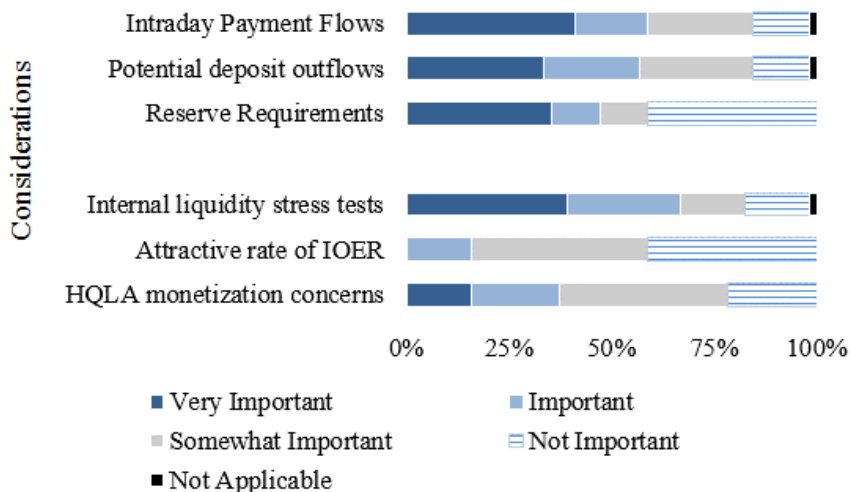
In order to better understand the possible sources of demand for reserves, the SFOS asked respondents to identify factors determining their lowest comfortable level of reserves. During outreach, banks often pointed to both internally driven guidelines and regulatory requirements as significant drivers of their reserve demand. As shown by the dark and light blue bars in Figure 2, two thirds of the SFOS panel reported that meeting internal liquidity stress test needs was important or very important when determining their lowest comfortable level. A majority of the panel also cited traditional demand drivers, such as intraday payment flows and potential deposit outflows, as important considerations. A larger percentage of small domestic banks cited these core business needs as important compared with the percentage that reported liquidity needs to be very important. This pattern was reversed for both U.S. Global Systemically Important Banks (GSIBs) and foreign banks.

¹³ It is staff’s experience individual banks have provided varying answers for their own demand for balances over time both up and down.

¹⁴ These ranges of reserve demand estimates were in line with those generated using a more granular approach which performed the same estimates based on bank business lines and an approach based on reserve reduction relative to current holdings.

Figure 2. **Demand considerations**

Importance of each consideration in determining the lowest comfortable level of reserves (as a percentage of survey respondents)

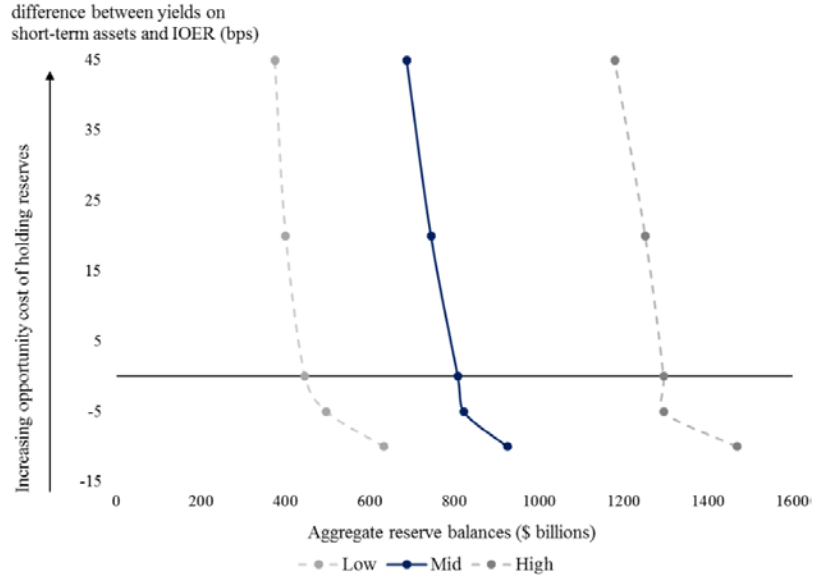


Depictions of interest elasticity of demand based on survey responses

The survey also asked banks how their lowest comfortable holdings would vary with changes in the constellation of short-term interest rates relative to IOER. Responses to these questions depend importantly on banks’ ability to forecast their reaction to market conditions that are materially different from those currently prevailing. In particular, survey respondents may not have fully accounted for how their business models, operating practices, or internal liquidity minimums might change in different market conditions and might, in practice, be more rate-sensitive than they reported. Indeed, roughly half of the banks on the panel reported that they would not adjust their lowest comfortable level of balances even if short-term market rates were to increase by as much as 50 basis points from where they were in August, bringing the spread of short-term rates over IOER to roughly 45 basis points. While this response might seem surprising in light of pre-crisis behavior, these findings were consistent with views that a number of large banks expressed during outreach. None of the U.S. GSIBs reported that there would be any change in their lowest comfortable level of reserves in response to a 5 basis point increase in market rates relative to IOER. In contrast, foreign banks reported some ability to reduce their lowest comfortable levels with incremental changes in the rate environment. Figure 3 shows estimates for aggregate reserve balances under different interest rate scenarios using the methodology described above. The blue curve depicts the demand for reserves at aggregated lowest comfortable levels. The dotted gray lines depict uncertainty around these estimates by applying the methodology described above.

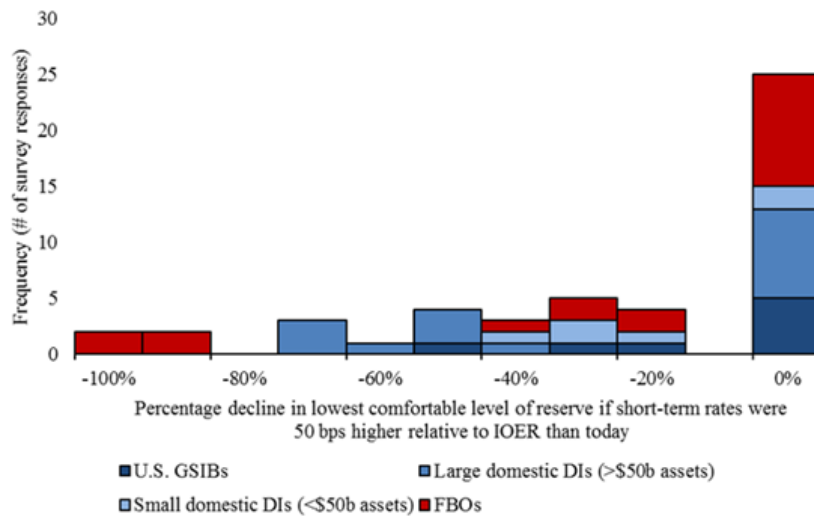
Figure 3. **Hypothetical demand curves**

Estimates of hypothetical lowest comfortable level of reserves in various interest rate environments (staff estimates based on survey responses)



About half of survey respondents indicated that they would be unwilling to adjust their lowest comfortable holdings in response to a substantial increase in the opportunity cost of holding these reserves, or did not respond to this question (Figure 4).

Figure 4. **Hypothetical demand elasticity at high opportunity cost**



Frequency at 0% also includes banks that did not respond to the question

Implications for market dynamics from the distribution of reserves

The point estimate of about \$800 billion for aggregate lowest comfortable level of reserves is still significantly below the \$1.8 trillion in reserves currently in the banking system. That said, as reserves decline, further upward pressure on market rates could arise. Reserve holdings are highly concentrated, with 20 banks holding close to 65 percent of total reserves in August 2018. A substantial share of surveyed banks report that they would not be willing to lend to other banks even at spreads of 25 to 50 basis points over IOER. Among the large banks included in the survey panel, only around 20 percent reported that they were willing to lend at spreads below 25 basis points. These results suggest that interbank lending alone may not be enough to efficiently distribute reserves through the banking system; other forms of redistribution may need to come into play, including competition for deposits. Differentiating in real-time between distributional, transitory frictions and widespread competition among banks for reserve balances may be challenging. As a result, a wide range of indicators will be necessary to assess the level of reserves consistent with bank demand and the efficient implementation of monetary policy.

Appendix: Markers of increasing competition to retain reserves

Table 1. Staff judgment on selected markers of increasing competition to retain reserves

Marker Description		2018 Q3 Assessment
Fed funds pressure	<ol style="list-style-type: none"> Increase in fed funds activity at rates above IOER Positive correlation between changes in aggregate reserve balances and changes in the IOER-EFFR spread. New participants in fed funds market 	<ul style="list-style-type: none"> Only about 5% of trades in fed funds are above IOER. High frequency changes in aggregate reserve balances are not correlated with changes in the IOER-EFFR spread. Little change in the set of participants active in the fed funds market.
Payments pressure	<ol style="list-style-type: none"> Shift in timing of payments toward end of day Increasing use of daylight overdrafts 	<ul style="list-style-type: none"> No evidence of a material change in the timing of payments. Banks have exhibited relatively little demand for intra-day credit from the FRS.
Reserve requirement pressure	<ol style="list-style-type: none"> Decrease in the fraction of banks with large buffers of excess reserves (relative to reserve balance requirement) Increasing use of primary credit (\$ amount and/or number of banks) 	<ul style="list-style-type: none"> Limited evidence of a decrease in the fraction of banks with large buffers of excess reserves. Discount window borrowing remains subdued.
Other funding pressures	<ol style="list-style-type: none"> Increasing deposit betas* Evidence of a pricing premium and/or increasing demand for LCR-friendly wholesale funding** 	<ul style="list-style-type: none"> Deposit betas are somewhat low compared to what is typical for this stage in a rising rate cycle. The share of volume in the fed funds market related to improving LCR metrics and meeting funding needs has increased relative to that for IOER arbitrage.

* Deposit betas are a measure of the pass-through of changes in the FOMC’s target range to deposit rates. For example, a 25 basis point increase in deposit rates following a 50 basis point increase in the target range corresponds to a deposit beta of 0.5.

** LCR-friendly funding can take many forms. Even borrowing less than 30 days can increase a bank’s LCR. For example, overnight unsecured borrowing from a FHLB receives a 40 percent outflow assumption under the U.S. LCR. Thus, if a bank borrows \$1 overnight from a FHLB in the fed funds market and places that dollar in its Fed account, the bank’s LCR will increase as its holdings of HQLA will increase by \$1 (numerator in LCR) while net outflow (denominator in LCR) will increase by \$0.40. The Desk estimates the share of fed funds volume related to improving LCR metrics and meeting funding needs as about 59 percent compared to about 41 percent for IOER arbitrage.

Table 2. **Explanations of selected markers of competition to retain reserves**

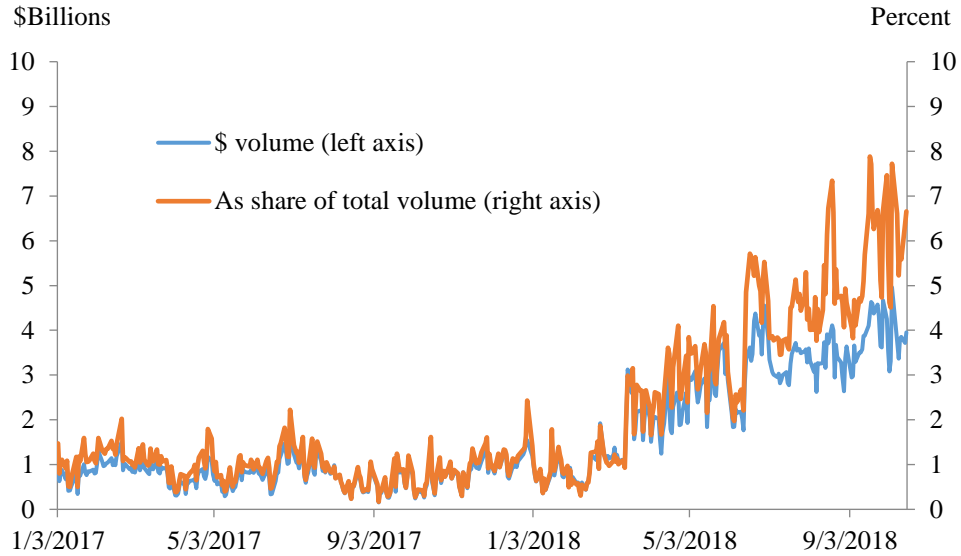
Marker Description	Marker Explanation
1. Increase in fed funds activity at rates above IOER	A substantial portion of current trading in the fed funds market is related to IOER arbitrage, which requires borrowing below IOER to be profitable. As banks begin to increasingly borrow for other reasons, they will be willing to pay higher rates, including above IOER. Additionally, as bank lenders enter the market, they will only be willing to do so at rates above IOER.
2. Positive correlation between changes in aggregate reserve balances and changes in IOER minus the EFFR rate	In an environment where reserves are scarce relative to the banking system’s demand, decreases in reserve balances will lead more banks to seek to borrow reserves, putting upward pressure on the EFFR. Examining high-frequency changes helps to remove unrelated trends in reserve balances and interest rates.
3. New participants in fed funds market	As aggregate reserves decline and the need to reallocate reserves emerges, new participants will likely need to borrow in the fed funds market. In addition, as rates in the fed funds market rise, the market should become more attractive to new lenders.
4. Shift in timing of payments toward end of day	With abundant reserves, banks can hold large buffers of excess reserves to make their outgoing payments without waiting to receive incoming payments first. As aggregate reserves decline, banks will have an incentive to match incoming flows to outgoing flows because their buffers of excess reserves will be lower. In order to meet their payment needs, they may shift the timing of their payments towards the end of the day as the timing of incoming payments becomes more certain.
5. Increasing use of daylight overdrafts	Lower excess reserve buffers may also increase banks’ use of daylight overdrafts from the Federal Reserve. ¹⁵
6. Decrease in the fraction of banks with large buffers of excess reserves (relative to reserve balance requirement)	As aggregate reserves decline, fewer banks will be able to hold large buffers of excess reserves.
7. Increasing use of primary credit (\$ amount and/or number of banks)	Lower excess reserve buffers may increase banks’ use of primary credit, either in terms of dollars borrowed and/or number of banks borrowing.

¹⁵ Staff analysis shows that about 45 percent of payments occur before noon (as of June 2018), as opposed to about 20 percent pre-crisis. As of June, there was no evidence that the 45 percent amount was starting to trend down. Staff have also looked at the time of the day when the 10, 25, 50, 75 and 90 percent of the day’s total value is transferred over Fedwire and found no evidence of a shift in payments towards the end of the day.

<p>8. Increasing deposit betas</p>	<p>As the availability of reserves declines, banks may seek to reduce their required liquidity buffers associated with funding profiles. Some deposit types have favorable regulatory treatment in terms of outflow assumptions, and we could expect banks to raise the rates on these deposits more in response to the short-term rate environment (higher deposit betas) than we have observed recently.</p>
<p>9. Evidence of a pricing premium and/or increasing demand for LCR-friendly wholesale funding</p>	<p>Overnight borrowing from FHLBs (in the fed funds market) receives more favorable treatment in the U.S. application of the LCR than borrowing from money funds (in the Eurodollar market) does. As banks comply with the LCR requirements and observe pressure on their reserve positions, we should observe increasing demand for LCR-friendly funding in the fed funds market, and the EFFR should trade higher than the Eurodollar rate creating a pricing premium in the fed funds market over the Eurodollar market. We may also observe increasing demand in term money markets (greater than 30 days).</p>

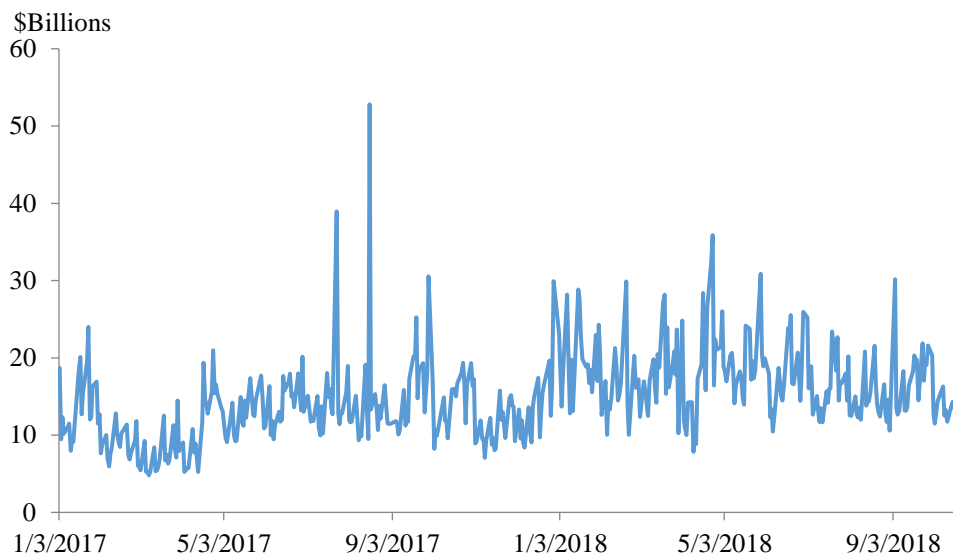
Markers

Figure A.1: Fed funds trading above IOER



Source: Federal Reserve

Figure A.2: Depository Institutions' Daily Peak Daylight Overdraft Balances



Source: Federal Reserve