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### **Factors Influencing the Demand for Reverse Repos<sup>1</sup>**

Anecdotal reports and the results of recent Desk surveys suggest that market participants have a wide range of views about the level of demand for overnight reverse repurchase agreement (ON RRP) operations during the months following liftoff.<sup>2</sup> While some market participants expect that demand in these operations will be similar to current levels, others believe that demand might rise considerably. This memo explores some of the factors market participants have cited as possibly influencing this demand over time.

The key findings are:

- Policy tightening could result in an increase in ON RRP demand if the rates paid on bank deposits or Treasury bills do not rise as quickly as the target range for the federal funds rate. In past tightening cycles, the spread between these assets and the target federal funds rate has tended to widen. However, IOER could affect these historical patterns, particularly if imperfect competition plays an important role in banks' rate setting behavior.
- New financial regulations may result in higher ON RRP demand over time.
  - Some large banks are seeking to shed deposits and reduce the overall size of their balance sheets in response to more stringent bank capital requirements. This could reduce the supply of private money-like assets, put downward pressure on deposit rates, and increase demand for other money-like assets, including ON RRP.
  - Money market fund (MMF) reforms are likely to cause shifts in assets from prime to government funds, which have a greater appetite for low-risk, money-like assets such as investments in the ON RRP.
- Debt ceiling constraints could lead to significant bill paydowns later this year, which could result in a temporary increase in demand for the ON RRP.
- Other factors discussed in the memo appear unlikely to have significant effects on ON RRP demand.
- Theoretical models of imperfect competition and balance sheet costs among participants in money markets do not predict an increase in ON RRP demand

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<sup>2</sup> In the June 2015 Survey of Primary Dealers, the 25th, 50th, and 75th percentile responses for ON RRP demand immediately following liftoff were \$150, \$200, and \$500 billion respectively. The same percentile responses for ON RRP demand one quarter prior to liftoff were \$100, \$150, and \$150 billion respectively. The survey questions and results are available on the Federal Reserve Bank of New York website.

resulting directly from policy tightening. Factors unrelated to policy tightening, such as constraints on the private sector's provision of money-like assets, could help explain an increase in ON RRP demand.

This memo is organized into three sections. The first two discuss various factors that could influence demand for ON RRP: the first focuses on effects related specifically to policy tightening, and the second discusses other factors, particularly those related to financial regulations. The third section considers models that have been developed to explain the current configuration of money market rates and aims to understand what frictions could explain an increase in ON RRP demand, should it occur.

## **I. Effects Related to Policy Tightening**

The direct effect of policy tightening on ON RRP demand depends significantly on the extent to which banks pass through increases in the federal funds rate to the rates paid on deposits. If banks increase deposit rates less than one-for-one with increases in the federal funds rate, this could put upward pressure on ON RRP demand. This is because the ON RRP rate is expected to increase at about the same pace as the federal funds rate, and the resulting change in relative pricing would create an incentive for investors to reallocate their portfolios between various short-term investments.

Historically, bank deposit rates have not increased as rapidly as the federal funds rate during policy tightening. Should this pattern continue, it is likely that the demand for ON RRP would increase over the course of normalization. However, the introduction of IOER in 2008 could affect this pattern.

As discussed in Section III, some theoretical models of money market activity suggest that the direct effect of policy tightening on demand in ON RRP operations could be fairly modest. In fact, because the spread between the IOER and ON RRP rates is expected to widen at liftoff, these models could predict a decline in demand for ON RRP. However, these models tend to predict that the spreads between market interest rates, such as bank deposits, and the Federal Reserve's administered rates will not change much as the Federal Reserve tightens policy. These results may not adequately capture the potential for changes in the configuration of money market rates and investor portfolios over time, particularly after a prolonged period at the zero lower bound.

Overall, it is difficult to gauge how much of an increase in ON RRP demand should be expected as a consequence of policy tightening. The balance of this section discusses several features of money markets that could result in changes in ON RRP demand as a result of policy tightening.

*During policy tightening, bank deposit rates have historically risen less than one-for-one*

Historically, deposit rates have been upwards-sticky and downwards-flexible, and the spreads between deposit rates and the effective federal funds rate (EFFR) have widened

following an increase in the target rate.<sup>3</sup> During the past three tightening cycles, the average deposit rate adjusted upward more slowly than the target federal funds rate and tended to accelerate later in the tightening cycle.<sup>4,5</sup> In particular, Figure 1 shows that during the past three tightening cycles, the typical pattern was for average deposit rates to rise by at most 20 basis points for the first 1 percentage point increase in the target rate, but rise by at least 50 basis points with the last 1 percentage point increase in the target rate. In addition, as shown in Figure 2, the spread between the EFFR and average deposit rates widened by roughly 100 to 200 basis points in the first two years of tightening. The implication of these empirical regularities for ON RRP demand during normalization is unclear, in part because during earlier tightening cycles the amount of excess reserves was small and reserves did not earn interest.

Two recent papers by Nagel (2014) and Drechsler, Savov, and Schnabl (2015) seek to account for the historical findings.<sup>6</sup> Both papers consider models in which money market investors have access to two assets that offer liquidity benefits, one with a fixed rate of return set to zero and another with a rate determined in equilibrium, as well as an asset that does not offer liquidity benefits and pays an interest rate tied to the EFFR. The two assets that offer liquidity benefits are at least partially substitutable in that respect. If the EFFR increases, the opportunity cost of holding the liquid asset that does not pay interest increases and, in equilibrium, there will be some substitution away from that asset. The increase in demand for the liquid asset that pays explicit interest will lead that rate to increase less than the EFFR.

In Nagel's model, the liquid asset that does not pay interest is non-interest bearing bank deposits, and the liquid asset that pays explicit interest is Treasury bills. He shows that the three-month certificate of deposit (CD)-Treasury bill spread tends to widen 6.7 basis points for every 1 percentage point increase in the EFFR.<sup>7</sup> For the upcoming tightening cycle, based on the target rate path implied by the median of the SEP projections, Nagel's results suggest that this CD-bill spread could widen 10 basis points over the next 18

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<sup>3</sup> See "Sticky Deposit Rates" by John Driscoll and Ruth Judson, Finance and Economics Discussion Series 2013-80.

<sup>4</sup> The three tightening cycles are 1993:Q4 to 1995:Q1, 1999:Q1 to 2000:Q2, and 2004:Q1 to 2006:Q3. The analysis is based on Call Report data. Because the Call Report does not distinguish between the interest expense that banks incur on retail versus wholesale deposits, interest expense on total interest-bearing deposits is used to measure the average interest paid on such deposits. See the "The Transmission of Monetary Policy to Deposit Rates" box in the "Report to the FOMC on Economic Conditions and Monetary Policy: Book B," April 23, 2015.

<sup>5</sup> Tealbook Book B also discussed the possibility that the pass-through from policy-rate changes to deposit rates may be different from in the next tightening cycle.

<sup>6</sup> See "[The Liquidity Premium of Near-Money Assets](#)," by Stefan Nagel, working paper, September 2014, and "[The Deposits Channel of Monetary Policy](#)," by Itamar Drechsler, Alexi Savov, and Philipp Schnabl, working paper, February 2015.

<sup>7</sup> This is for his 1991-2007 sample period and is based on large denomination (uninsured) certificates of deposit. Effects are larger (8.1 basis points) for the 1976 to 2007 period. Effects for the 3-month repo-Treasury bill spread (only available for a shorter sample period) are similar (5.4 basis points). These estimates are largely based on pre-crisis data, and whether these relationships would hold in the current environment is uncertain.

months and 24 basis points in the longer run.<sup>8</sup> The simplifying assumption that banks do not pay interest on deposits may not be problematic when reserves do not earn interest, as was the case over the sample Nagel considers, but IOER could affect banks' rate-setting behavior.

In Drechsler, Savov, and Schnabl's model, the liquid asset that does not pay interest is cash and the liquid asset that does pay explicit interest is bank deposits. Banks are assumed to have some market power and can earn higher profits by not increasing deposit rates as much as the federal funds rate. These authors show that as the EFFR rises, rates on bank deposits increase, but less than one-for-one, so spreads widen. In this model also, the presence of IOER could modify the results.

As will be discussed in Section III, with limited competition banks can earn an IOER-arbitrage profit, which creates an incentive for banks to hold on to reserves rather than allow investors to place money at the ON RRP. Hence, if limited competition is important, the presence of IOER, and ON RRPs, could lead to a different rate-setting behavior than has been observed in the past.

*Portfolio allocations to bank deposits may reflect zero lower bound effects*

Over recent years, the volume of liquid deposits at banks has grown enormously (from \$4 trillion to more than \$7.5 trillion), as shown in Figure 4. One possible interpretation is that this reflects the compression in yields due to the proximity of the zero lower bound, so that depositors that now choose to allocate more heavily towards savings accounts, as suggested by Figure 5. If that is indeed the case, moving away from very low rates may not imply large deposit outflows because banks could raise time deposit rates to capture the outflow from unremunerated liquid deposits; so one would expect a change in the composition of deposits from liquid deposits to time deposits but not much change in the total demand for deposits. However, it is also possible that a significant volume of such liquid deposits are held by investors that are simply parking funds in the zero interest rate environment but that might be lured away when money market rates begin to move well above rates offered on liquid deposits.

If that is the case, one likely destination for funds leaving the banking sector is government MMFs, because these funds' shares are also money-like. The magnitude of outflows to government MMFs would likely depend, among other things, on the yield they can offer. While the spread between MMF yields and deposit rates is expected to increase as money market rates increase, this effect may be tempered by the fact that MMFs are unlikely to pass along all of the increase in market rates immediately to

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<sup>8</sup> See "How might policy rate normalization affect ON RRP takeup?" Michael Fleming, FRBNY memo, July 2015. The median appropriate fed funds target rate (or target range midpoint) in the June 2015 Summary of Economic Projections for the end of 2016 is 1.625 percent, implying a tightening of 1.5 percent (1.625 percent minus the current target range midpoint of 0.125 percent) over the next 18 months. This implies a widening in the CD/Treasury spread of 10 basis points (6.7 basis points  $\times$  1.5). The longer run fed funds target rate is 3.75 percent, implying a tightening of 3.625 percent (3.75 percent - 0.125 percent) and hence an ultimate spread widening of 24 basis points (6.7 basis points  $\times$  3.625).

investors. Indeed, as market rates move up, MMFs may begin to raise their fees from their historical lows (since late 2008, most MMFs have been waiving very significant portions of their normal fees to prevent the net yields paid to their investors from dipping below zero) to more normal levels.<sup>9</sup> Shifts in money from bank deposits to MMFs may be muted if MMF yields do not move up one-for-one with market interest rates.

*GSE behavior may be influenced by zero lower bound effects*

The government sponsored enterprises (GSEs) have access to unremunerated reserve accounts at the Federal Reserve. Because the accounts earn no interest, the opportunity cost of leaving funds in them rises as policy is tightened. As a result, the GSEs may reduce their use of these accounts during normalization, and this substitution could result in an increase in demand for ON RRP. In addition, the presence of these accounts may currently provide the GSEs with leverage when they negotiate rates with their counterparties. As the opportunity cost of using the accounts rises, the GSEs may have less bargaining power in their negotiations, which could result in lower money market rates. Such a change could also result in higher ON RRP take-up.

Fannie Mae and Freddie Mac's demand for ON RRP is mainly tied to their principal and interest (P&I) payment cycles. The day before these payments are due, they tend to maintain substantial reserve balances, allowing them to make these payments early the following morning. As the opportunity costs of these deposits increase, Fannie and Freddie may seek to direct some of these funds to the ON RRP facility. However, these operations do not offer an early-morning return feature. Alternatively, they could seek investment opportunities in markets that allow for early return of invested funds, such as the federal funds or bilateral repo markets, in which they currently do not participate.<sup>10</sup> This could put downward pressure on money market rates, perhaps putting upward pressure on ON RRP demand.

Federal Home Loan Banks (FHLBs) can issue debt at favorable rates in comparison to many private financial institutions. FHLBs can earn a spread by borrowing cheaply, through the issuance of short term discount notes, and investing the proceeds in higher-yielding money market products of similar maturities, such as the ON RRP.<sup>11</sup> There are, however, significant regulatory and operational constraints on this type of FHLB activity. Moreover, data suggests that the total amount of discount notes issued by FHLB with the purpose of investing in the ON RRP is currently small.<sup>12,13</sup>

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<sup>9</sup> "How Sensitive are Money Management Fees to the Level of Interest Rates?" by Adam Biesenbach and Jacqueline Yen, MarketSOURCE, August 2014.

<sup>10</sup> Fannie and Freddie's internal investment policies currently do not permit unsecured lending.

<sup>11</sup> For more information on the FHLBs, see "[Primer: FHLB Liquidity Management and its Impact on the Fed Funds Market](#)," by Eric LeSueur, MarketSOURCE, October 2014.

<sup>12</sup> FHLBs must meet various capital requirements, including a risk-based capital ratio and two variations of a non-risk-weighted capital ratio. Other constraints include payment and settlement timing frictions associated with maturing DNAs and money market investments. Debt statistics from the FHLB Office of Finance can be found [here](#).

<sup>13</sup> Overnight discount note issuance (some of which may be for non-arbitrage purposes) has recently averaged around \$11 billion over 2015, a small share of the \$400 billion in FHLB discount notes

*MMFs could reduce portfolio maturities*

Because MMFs are particularly risk averse, they may shorten maturities ahead of potential increases in short-term rates associated with policy tightening, since shorter maturities dampen the effects of interest-rate changes on funds' mark-to-market NAVs. MMFs seeking to shorten maturities could choose to invest at the ON RRP facility. A shortening of prime MMF weighted average maturities (WAMs) has already occurred in recent months. Aggregate WAM dropped from an average of about 46 days in 2014 to 37 days at the end of June 2015. However, this recent downtrend has not been accompanied by an increase in prime MMFs' ON RRP take-up.

## **II. Effects Not Directly Related to Policy Tightening**

This section discusses several factors that could result in an increase in ON RRP demand but that are not directly related to monetary policy tightening. The factors that appear most likely to affect future demand for ON RRPs are bank regulations, which are expected to lead to diminished supply of private money-like assets, and MMF reform, which could lead to greater demand for money-like assets, especially those issued by the official sector. Also discussed are negative interest rates in Europe and effects related to the demand for and supply of Treasury securities.

*Bank regulatory reforms may reduce supply of money-like assets*

Usage of the ON RRP facility may increase because of a decrease in the supply of money-like assets provided by banks, leading to a shift of funds out of the banking system. Three regulatory requirements that raise balance sheet costs provide incentives for the largest banks to shed certain deposits, particularly the nonoperational deposits of financial firms.<sup>14</sup> First, the liquidity coverage ratio (LCR) assigns financial nonoperating deposits a run-off rate of 100 percent, so each dollar of such deposits must be matched to a dollar of high quality liquid assets. Second, the enhanced Supplementary Leverage Ratio (eSLR) will require capital to be held against these assets, regardless of their risk. The cost of the additional capital could well exceed the revenue generated by high quality liquid assets, especially in a low interest rate environment. Lastly, banks designated as global systemically important banking organizations (GSIBs) could potentially be assigned a lower GSIB score if they shed some of these deposits.

An example of how regulations may affect demand for ON RRPs is JP Morgan Chase's announcement that it will reduce its nonoperational deposits by up to \$100 billion in 2015 in response to regulatory costs. Some analysts estimate that as much as \$450 billion of

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outstanding. It should be noted, however, that the FHLBs could use other discount note maturities for money-market arbitrage as well.

<sup>14</sup> Nonoperational deposits are those owed to depositors other than retail or small business customers and that do not meet the criteria for operating deposits, such as by providing payment or settlement services.

nonoperational deposits could leave the four largest banks.<sup>15</sup> However, these estimates are based on publicly available data that provide only a coarse measure of such deposits. Using more detailed confidential supervisory data and a similar methodology, preliminary staff analysis suggests that the outflow of nonoperational deposits at the GSIB banks could be considerably lower, around \$300 billion.<sup>16</sup>

A great deal of uncertainty surrounds these estimates, but the demand for ON RRP could increase significantly if banks substantially reduce their nonoperational deposits. The ultimate impact on ON RRP take-up would depend on where the deposits go. The depositors that are most likely to be affected are hedge funds and some foreign central banks. Compared with other depositors, these customers tend to generate relatively little revenue for banks from trade execution, cash management, securities lending fees, and other fee-generating business. Some of these depositors' money is likely to end up at the ON RRP facility.

Government MMFs likely would attract some of their money, since those funds will be permitted to maintain stable net asset values (NAVs) under the new SEC MMF rules. Also, many of the large institutions that currently take these deposits operate large asset-management businesses that offer these products. Government MMFs probably would seek to place a substantial portion of the additional investments in the Fed's RRP facility, so such a shift could increase ON RRP demand. Assuming \$300 billion in outflows, the best estimates of the potential increase in demand for ON RRP is in the range of \$50 to \$90 billion.<sup>17</sup> This assumes that all outflows are invested in government MMFs with access to ON RRP. On average over the past year, government MMFs that are Federal Reserve RRP counterparties have invested 17 percent of their assets in ON RRP, and the share of their assets invested in ON RRP has climbed to about 30 percent at recent quarter ends, when the supply of alternative investments shrinks. Even larger government MMF investments in ON RRP would be likely if the supply of other short-term assets cannot accommodate the funds' growth, although MMF managers facing a shortage of assets in which they can invest may also close their funds to new share purchases.

Deposits also could flow to destinations that would not contribute to ON RRP demand. These might include regional banks, which are not subject to equally stringent regulatory requirements. Deposits could also be placed in segregated accounts at nonbank asset managers. Finally, foreign central banks may take advantage of their ability to enter into

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<sup>15</sup> See "JP Morgan Chase Announces Efforts to Reduce Wholesale Deposits by Year's End," by Jeffrey Levine and George Eckerd, MarketSOURCE, March 2015.

<sup>16</sup> The eight Large Institution Supervision Coordinating Committee (LISCC) banks are Bank of America Corporation, Citigroup Inc., JP Morgan Chase & Co., Wells Fargo & Company, The Bank of New York Mellon Corporation, State Street Corporation, The Goldman Sachs Group, Inc., and Morgan Stanley. These banks are estimated to collectively hold \$1.15 trillion in nonoperational deposits. Details on how this estimate was calculated can be found in "Shedding of nonoperational deposits at LISCC banks and potential implications for the implementation of monetary policy," by F. Covas, J. Huther, A. Kumbhat, J. Louria, J. Rose, and J. Wu, Board of Governors of the Federal Reserve System Internal Memo, May 2015.

<sup>17</sup> See the "Bank Regulation, Deposit Outflows, and the Demand for ON RRP" box in the "Report to the FOMC on Economic Conditions and Monetary Policy: Book B," June 11, 2015.

overnight reverse repurchase transactions backed by U.S. Treasury and agency securities with the Federal Reserve Bank of New York.<sup>18</sup>

Regulatory requirements are also affecting some dealer subsidiaries of large banks. These dealers have stated that the eSLR pressures them to reduce their repo books, particularly against high quality collateral such as Treasuries and agency MBS, and there has been a reduction in the size of the tri-party repo market backed by these assets, particularly Treasuries. This adjustment in dealers' balance sheet has been accompanied by an increase in usage at the ON RRP facility.

*MMF reform may result in a reallocation into government MMFs and shorter maturities*

Developments in the MMF industry could potentially increase demand for ON RRPs. First, MMF reforms that were adopted by the SEC in 2014 are likely to cause shifts in assets to government MMFs, which make relatively heavy use of ON RRPs. Second, some anticipated shortening of the maturities of MMF portfolios may boost ON RRP take-up.

The SEC's 2014 MMF reforms included two provisions that may make prime MMFs less attractive for cash management, particularly in comparison to government MMFs. Both provisions must be implemented by October 2016, and neither of them applies to government funds. Institutional prime funds must implement floating net asset values (NAVs), and all prime funds—institutional and retail—must be able to impose liquidity fees and gates in the event that liquid assets drop below certain thresholds.

The responses of MMF firms and investors to these new requirements may expand the assets of government MMFs. For example, several MMF families have announced plans to convert prime funds to government funds as a result of the reforms. Plans announced to date indicate that about \$150 billion in prime fund assets are slated for conversion, and more announcements are likely. In addition, MMF investors who wish to avoid a floating NAV or the possibility of redemption fees and gates may shift money away from prime funds, and government MMFs are one likely destination for their cash. Industry analysts have suggested that shifts into government MMFs motivated by the SEC's MMF reforms could be \$300 billion to \$500 billion.<sup>19</sup> However, these figures are subject to considerable uncertainty. On the one hand, some market participants have suggested that the shifts could be much larger, but on the other, prime MMF investors could shift assets to a variety of other vehicles that do not invest in ON RRPs, such as unregistered liquidity funds, separately managed accounts, and ultrashort bond funds.

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<sup>18</sup> The FIMA (Foreign and International Monetary Authorities) repo pool comprises overnight repurchase agreements between the Federal Reserve and its foreign central bank and international account customers. Foreign central banks maintain short-term investments at the Federal Reserve to execute their dollar-denominated daily transactions. An increase in the pool drains reserve balances from the banking system as foreign central banks and international account customers move money from depository institutions to the Federal Reserve.

<sup>19</sup> See "MMF Changes Elicit Concerns for Greater than Expected Potential Prime Fund Outflows," by Neha Shah, Catherine Chen, and Jon Hill, MarketSOURCE, March 2015.



Because government funds that are Federal Reserve RRP counterparties tend to invest about 15 percentage points more of their assets in Federal Reserve RRP than do prime fund counterparties, all else equal, the predicted increases in government MMF assets resulting from MMF reforms might boost ON RRP demand by roughly \$50 billion to \$75 billion.<sup>20</sup> However, there are upside and downside risks to these estimates. Larger boosts to ON RRP demand could occur if the supply of other instruments eligible for government MMFs to purchase is not adequate to accommodate those funds' growth, as some market participants reportedly expect. However, the increase in ON RRP demand might be reduced if cash currently in prime MMFs moves to other types of investment vehicles that do not use ON RRPs.

A shortening of MMF portfolio maturities may also contribute to increased ON RRP demand, although the effect would probably be modest. Such a shortening could be prompted by the new MMF rules (and, as noted above, by anticipated increases in short-term interest rates). For example, some MMF families have announced plans to offer prime MMFs that limit the maturities of all assets to 60 days or less. This self-imposed constraint would be intended to limit potential share price movements in funds that nominally have floating NAVs.<sup>21</sup> However, a fund that limits maturities of its portfolio assets in this manner would not necessarily increase its demand for ON RRP or other overnight assets (for example, eliminating assets that mature in more than 60 days would allow a fund to hold *less* overnight instruments without increasing its portfolio weighted average maturity).<sup>22</sup> Moreover, to the extent that such a strategy succeeds, it could dampen the expected shift in assets from prime to government MMFs.

Prime MMFs may also reduce portfolio maturities and augment liquid asset holdings to prepare for potential redemptions by investors who prefer to avoid the provisions mandated under the SEC's new rules.

#### *Negative overnight rates in Europe may result in behavioral effects*

Negative interest rates in Europe might lead to an increase in demand for ON RRPs, perhaps due to behavioral incentives, given the aversion of some investors to earning negative rates. For example, some investors could prefer an FX loss to a negative-yielding money market instrument, even if they have the same economic return, if the FX

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<sup>20</sup> The \$50 billion to \$75 billion potential increase in ON RRP demand cited here is based on the assumption that the shift to government-only MMFs occurs only among funds that are Federal Reserve counterparties. A downward adjustment would be needed if some money flows instead to non-counterparty MMFs. At the end of June 2015, Federal Reserve RRP counterparties accounted for 87 percent of the assets of prime MMFs and 65 percent of the assets of government-only MMFs.

<sup>21</sup> SEC guidance allows mutual funds to value debt securities with remaining maturities of 60 days or less at amortized cost if the fair value of the securities is their amortized cost. However, recently published SEC FAQs discourage MMFs from using this strategy to avoid NAV fluctuations.

<sup>22</sup> Many funds use "barbell" strategies, holding some very long-dated assets to increase yield and holding a large share of short-dated assets to stay well within regulatory WAM/WAL limits. A reduction in the long-dated holdings of these funds could be accompanied by a reduction of the short-dated assets.

loss is less conspicuous.<sup>23</sup> These investors could also have strong demand for safe money-market investments in the U.S. (e.g., Treasury bills or ON RRP, rather than higher yielding private sector repo or unsecured investments).

So far, investment decisions based on this type of aversion to negative rates does not seem to have had a material impact on U.S. money market rates.<sup>24</sup> Notably, Treasury bill rates have generally remained positive amidst negative euro-area rates, and ON RRP take-up does not appear to have been affected by the negative rates. It is possible that more deeply negative rates could potentially trigger deposit outflows to countries with nonnegative interest rates.

These types of behavioral incentives would be primarily driven by the existence of negative rates, and not by the presence of an interest rate spread, so they are not expected to be affected by policy tightening. In any case, an increase in the differential between U.S. and euro-area short- and long-term interest rates is not expected to lead to an increase in ON RRP demand either.

The cost of the FX swap for an investor in a euro-area country who is considering holding dollars on a FX-swapped (or hedged) basis, reflects U.S. interest rates, foreign interest rates, and the swap basis.<sup>25</sup> Holding the swap basis fixed, the FX swap will re-price in response to changes in the interest rate spread so that the relative attractiveness to an FX-hedged investor of dollar- and euro-based investments will be unchanged. Historically, the swap basis has not had any consistent relationship to interest rate differentials, and as can be seen in Figure 3, the swap basis is usually negative (because dollar funding is usually valuable) and has become more negative recently, making FX-hedged investments in short-term dollar instruments especially unattractive as compared to just accepting the ECB's negative rates.<sup>26</sup>

Investors could also engage in simple, unhedged carry trades, which may become more attractive as the differential between U.S. and euro-area rates increases. However,

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<sup>23</sup> Some corporate treasurers have opted to swap cash balances to positive-interest-rate currencies such as dollars or yen. Even though these swaps are currently uneconomic, they allow treasurers to report positive interest income but negative FX income, which they reportedly view as more palatable to corporate boards. In contrast, money funds and reserve managers that hold euro-denominated assets have responded to negatives rates by extending duration and moving down the credit spectrum. See “Negative Policy Rates Transmit to European Money Markets,” by Liza Reiderman and Alexander Tepper, MarketSOURCE, March 2015.

<sup>24</sup> Thus far, there has been no apparent increase in demand for cash, gold or other noninterest-paying assets in any of the countries with negative interest rates, nor have deposits fled to countries with nonnegative rates. Currently, most retail bank deposits are not paying negative rates, but larger corporate deposits are. See the “The Transmission of Monetary Policy to Deposit Rates” box in the “Report to the FOMC on Economic Conditions and Monetary Policy: Book A,” March 11, 2015.

<sup>25</sup> The FX swap basis is the difference between the interest rate implied by the covered interest parity relation (CIP) and the actual interest rate.

<sup>26</sup> The series labelled “EUR” in Figure 1 charts the returns from a daily euro repo index (Bloomberg ticker: REFRDE). The series “USD” charts the return achieved when euros are swapped into dollars and then invested in USD daily repo (Bloomberg ticker: GCFRT1WK). The swap basis is the difference between the USD and EUR returns.

investors who can tolerate this type of FX risk may want to invest in dollar assets with a higher yield than that offered by ON RRP. Indeed, in recent months euro-area purchases of dollar assets that have higher risks and return, such as corporate bonds, have notably increased, while the rise in U.S. government securities flows has been smaller.<sup>27</sup>

*Reduced supply of Treasury bills might temporarily increase ON RRP demand*

Demand for short-term, high-quality dollar-denominated assets is expected to grow significantly over the coming years because of the regulatory changes noted above.<sup>28</sup> This is expected to put downward pressure on bill rates and could increase demand for ON RRP. Treasury has announced that it is planning to increase its issuance of bills to meet market demand and to help fund an increase in its operating cash balance to a minimum of \$150 billion, and this increase could partially offset the pressure on bill rates. However, most analysts have argued that the increase would likely not be sufficient to meet the additional demand for Treasury bills.

In addition, another debt ceiling episode could potentially result in a temporary increase in demand for ON RRP later this year or early next year.<sup>29,30</sup> Market participants generally expect that if Treasury exhausts its extraordinary measures to meet its payment obligations this fall, this could potentially result in greater demand for alternatives to Treasury bills, which may potentially be at risk of a technical default or delayed payment.

More broadly, debt ceiling dynamics could lead to a significant decline in bill supply. As extraordinary measures are exhausted and the debt ceiling becomes a binding constraint, Treasury's ability to issue new debt will be determined by the amount of debt maturing, and Treasury either will have to allow the bill supply to run down or make cuts to coupon auction sizes. Most market participants expect Treasury to focus on the former in order to avoid drastic changes in its schedule of coupon security auctions. One market participant estimates that the cumulative bill paydowns could exceed \$200 billion between mid-September and Thanksgiving, and internal staff forecasts are generally consistent with this scenario.<sup>31,32</sup> However, the resulting decline in bill supply would likely be temporary as Treasury would be expected to quickly ramp up bill issuance once

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<sup>27</sup> These flows are calculated using the Treasury International Capital (TIC) data. See "Recent euro-area inflows into U.S. bonds: Reconciling and understanding new data sources," by Carol Bertaut and Ruth Judson, June 19, 2015.

<sup>28</sup> See "Supply/Demand Imbalance in Treasury Bills Expected to Suppress Bill Rates" by Jon Hill and Eric LeSueur, MarketSOURCE, June 2015.

<sup>29</sup> The views on the timing for when extraordinary measures would be exhausted were expressed in market commentary published in the spring and summer of 2015.

<sup>30</sup> Please see "Market Update: Debt Limit Likely to Bind in Late 2015" by Paul Santoro, MarketSOURCE, July 2015.

<sup>31</sup> See Wrightson's "The Money Market Observer," June 22, 2015.

<sup>32</sup> Board staff forecast that Treasury's cash balance will be \$207 billion at the end of September and Federal Reserve Bank of New York staff estimate that the cash balance will exceed \$200 billion in the second half of September. Both staffs expect that if the impasse extends deep into the fall and extraordinary measures are nearly exhausted then Treasury will need to cut back on bill issuance and allow the cash balance decline in order to extend the amount of time it can keep the government running normally.

the episode was resolved. Until that point, there would likely be increased demand for bill substitutes, including ON RRP.

### III. Theoretical Perspectives on ON RRP Demand

Staff has developed a variety of models to explain the current configuration of money market rates.<sup>33</sup> While these models were not designed to address the question of the demand for ON RRP, they could nevertheless be useful to identify the frictions responsible for an increase in demand, should it occur. Researchers have identified a few frictions that could explain the spread between money market rates and IOER.<sup>34</sup> This section focuses on two such frictions: balance sheet costs and imperfect competition.<sup>35</sup> Models incorporating either friction suggest that ON RRP demand would not be expected to increase much at liftoff and may even decrease slightly.<sup>36</sup> An increase in ON RRP demand, should it occur, would thus likely be due to other frictions not included in these models. The factors considered in Section II suggest that considering a friction related to the demand for money-like assets could be fruitful.

#### *Models with balance sheet costs*

A bank that faces balance sheet costs will not borrow in money markets unless the spread between the IOER rate and money market rates can cover the cost of the bank's balance sheet increase. Hence, balance sheet costs prevent money market rates from converging to the IOER rate. The pull from the IOER rate on money market rates may remain quite strong, but a spread that reflects these costs will persist.<sup>37</sup> Examples of relevant balance sheet costs include the FDIC assessment fee and the costs associated with new regulatory requirements discussed in Section II. While the FDIC assessment fee is roughly constant as a proportion of the bank's balance sheet, other regulatory costs may be increasing with size of the balance sheet.<sup>38</sup>

If balance sheet costs are the only material friction and they remain sufficiently low, then, after the effects of IOER are taken into account, ON RRP are not likely to play a

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<sup>33</sup> Several of these models are explained in a memo to the FOMC on April 17, 2014 entitled "Analytical Perspectives on Federal Reserve Policy Tools," by Anna Nordstrom, Julie Remache, Han Chen, Beth Klee, Antoine Martin, David Miller, Ed Nosal, and David Skeie.

<sup>34</sup> In the absence of frictions, economic theory would suggest that competition amongst banks, which can earn IOER, would bid up deposit rates until they are very close to the IOER rate, even if many money market lenders cannot hold reserves and GSEs cannot earn interest on the reserves they hold.

<sup>35</sup> Another friction that has been studied, preferred habitat, has implications similar to those of the balance sheet cost friction.

<sup>36</sup> In models with balance sheet costs, ON RRP demand can be high for some parameterizations, but increasing interest rates would not lead to higher demand.

<sup>37</sup> Note that balance sheet costs could vary over time, which would result in changes to the spread between IOER and money market rates.

<sup>38</sup> For example, the cost of capital could be increasing in the amount of capital being raised. As an alternative to adding capital, a bank could keep its leverage ratio constant by shedding other assets when the level of its reserves increases. The cost of this adjustment is likely to be increasing with the amount of reserves since the balance sheet will move further away from its desired composition.

material role in supporting money market interest rates. In such a scenario, money market rates would probably remain close to the IOER rate and, reflecting credit risk and term premiums, above the ON RRP rate, and ON RRP usage would not be expected to increase at liftoff.

Alternatively, balance sheet costs may be so large that the spread between the IOER rate and money market rates would be greater than 25 basis points, in the absence of an ON RRP facility. In that case, the availability of ON RRP would play an important role in keeping money market rates within the target range. ON RRP take-up directly reduces the amount of reserves held by banks in aggregate, which reduces their balance sheet costs. In equilibrium, ON RRP usage increases until banks' balance sheet costs are sufficiently low to bring about a level of money market rates at which investors are indifferent between lending to banks and lending at the ON RRP.

If ON RRPs are currently supporting money market rates by lowering banks' balance sheet costs, then take-up might be expected to decrease somewhat at liftoff. In particular, because the spread between IOER and the ON RRP rate is expected to widen from 20 basis points to 25 basis points, the indifference point between money market lending and ON RRP lending should fall and lead to lower take-up, and the spread between IOER and money market rates would increase by a small amount.

#### *Models with imperfect competition*

Models that focus on imperfect competition among banks that can profit from the spread between IOER and money market rates lead to different predictions. In these models, the pull of the IOER rate is weak, and raising only the IOER rate would not lead to a similar increase in money market rates. Thus, the ON RRP facility would play an essential role in raising money market rates at liftoff, as it provides money market investors with an outside option that allows them to obtain better rates than would be available absent ON RRPs.

An implication of imperfect competition models is that usage at the ON RRP facility is expected to be very low. In these models, banks earn arbitrage profits from the reserves they hold and, since every dollar in ON RRPs reduces the amount of reserves, one might expect banks to offer money market lenders rates that are sufficiently attractive to dissuade them from lending to the ON RRP facility. Indeed, it is preferable for banks to borrow at a rate slightly higher than the ON RRP, rather than not borrow at all and lose the profit opportunity entirely. For that reason, in contrast to models that rely on balance sheet costs only, changing the spread between the IOER and ON RRP rates would not result in a change in ON RRP demand.<sup>39</sup>

ON RRP demand could be positive, in this kind of model, if banks have to pay the same interest rate to all lenders from which they borrow. Indeed, banks may be willing to tolerate losing some reserves to the ON RRP if they can pay a lower interest rate on the

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<sup>39</sup> This will be true as long as the spread between the IOER and ON RRP rates is large enough to allow for some arbitrage profits by banks.

deposits they keep. Nevertheless, one would not expect ON RRP demand to be large since banks only earn profits on the reserves they hold.

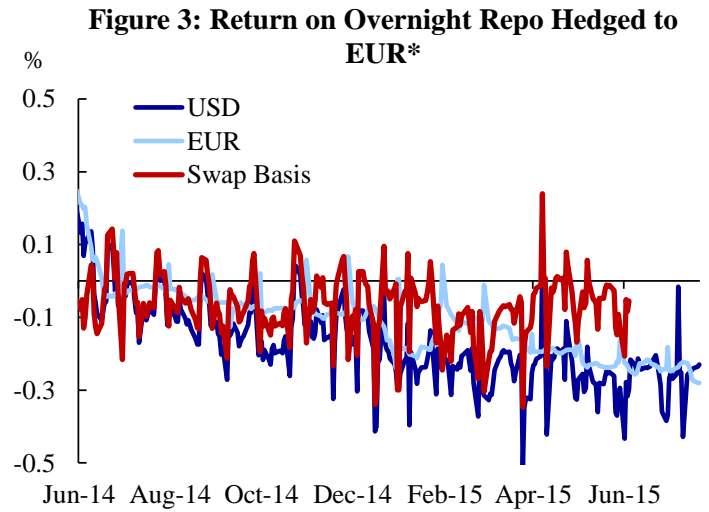
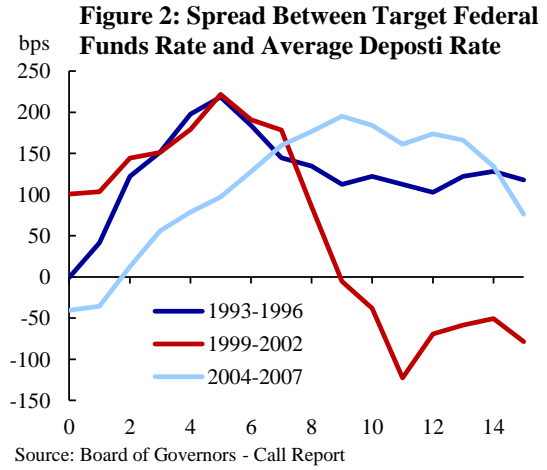
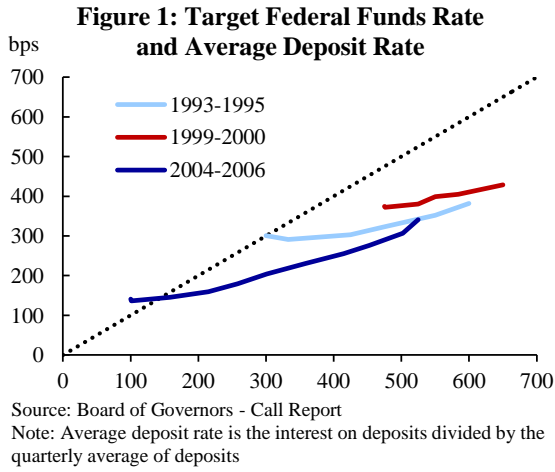
Overall, the frictions considered in the theoretical models reviewed in this section would not help explain an increase in ON RRP demand driven by policy tightening, should such an increase happen. The factors reviewed in the earlier sections suggest that ON RRP demand could increase because the supply of privately-issued money-like assets is insufficient to meet the demand for such assets, and ON RRPs are in some cases a close substitute. This effect is not captured in the models reviewed here.

Models with balance sheet costs could be modified to capture this effect, at least partially. If banks find it difficult to charge negative interest rates on their deposits, it is possible that balance sheet costs are greater than the current level of demand for ON RRPs would suggest. Indeed, the costs of holding nonoperational deposits at banks would not reflect the full cost incurred by the bank. When policy tightens, the opportunity cost of these deposits could increase, leading to greater outflow of deposits from banks and, as noted earlier, to an increase in the demand for ON RRPs. This effect could become stronger as the IOER and ON RRP rates are raised farther away from zero, so ON RRP demand could continue to grow as interest rates increase. Hence, if a large increase in ON RRP demand is observed at liftoff, a better understanding of the costs of private-issuance of money-like assets could be fruitful.

#### **IV. Summary**

This memo has reviewed a number of factors that could contribute to increased demand for ON RRP investments over time. Quantifying the effects of these factors is challenging, and estimating the potential direct effects of the increase in policy rates in boosting demand for ON RRP investments is particularly difficult. As discussed in section III, existing models do not incorporate frictions that would explain such an increase, should it occur. Given the very large volume of liquid deposits at banks, there is some potential for substantial outflows of deposits from banks to money funds and ultimately higher ON RRP take-up. Models that capture the costs of private issuance of money-like assets may help explain such an increase. An increase in demand for ON RRPs could occur gradually over time if investors respond slowly to a widening gap between money market rates and rates offered by banks on liquid deposits.

**Figures**



The series labelled "EUR" charts the returns from a daily euro repo index (Bloomberg ticker: REFRDE). The series "USD" charts the return achieved when euros are swapped into dollars and then invested in USD daily repo (Bloomberg ticker: GCFRT1WK). The swap basis is the difference between the USD and EUR returns

