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## **Demand and Supply Considerations in Repo Rate Targeting Regimes**

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### 1 Introduction

One of the possible rates the Committee could choose to target in the future is the overnight rate on Treasury repurchase agreements (hereafter, repo rate).<sup>2</sup> As noted in the forthcoming “Alternative Policy Rates” memo, there are several considerations that might incline the FOMC to choose the repo rate as a target in the new long-run operating framework. Perhaps most importantly, the repo rate is a close proxy for the “risk-free” overnight rate that forms the basis for the pricing of all dollar-denominated financial assets. The repo market is also large, long-standing, and central to the financial system, and has tended to remain active during periods of financial stress. As a result, targeting the overnight repo rate would provide the Committee with an important lever for influencing overall financial conditions.

At a high level, through its policy actions and communications, the Federal Reserve would manage the current and expected future path of overnight repo rates. The expected future path of overnight repo rates would then influence the yields on longer-term Treasury securities, and the prices of a range of other asset prices would be affected in the usual way through arbitrage by market participants.

As discussed in the “Considerations for the Design of Reserves Operating Regimes” memo, the operational aspects of implementation frameworks aimed at targeting unsecured bank funding rates often center on issues related to demand and supply in the reserve market. In these regimes, apart from so-called “autonomous factors,” the Federal Reserve is the sole supplier of reserves to the banking system. Moreover, the Federal Reserve has a substantial degree of

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<sup>1</sup> We thank Jim Clouse for valuable comments and Grant Carney for excellent research assistance.

<sup>2</sup> Throughout this memo we refer to a generic “repo rate” on overnight general collateral Treasury repurchase agreements. In practice there are several repo rates, reflecting market segmentation and different settlement conventions, including customer tri-party rates and customer bilateral repo rates. These differences would deserve further staff analysis if policymakers decided to adopt a repo rate as the policy rate, but do not substantively affect the analysis presented in this memo.

influence over the demand for reserves through reserve requirements and the interest rates on required and excess reserves. In these types of systems, the Federal Reserve can influence the level of the federal funds rate or other unsecured bank funding rates by appropriate adjustments of the supply of reserves and the interest rates on reserves.

As discussed in more detail below, demand and supply conditions in the reserve market certainly can be a factor influencing outcomes in the repo market. However, the demand and supply of reserves would likely move to the background as key focus of policy implementation.<sup>3</sup> Instead, the primary focus of policy implementation under a repo rate targeting regime would likely shift to demand and supply conditions in the repo market. As discussed below, the Federal Reserve could influence those demand and supply conditions using a variety of tools at its disposal.<sup>4</sup>

Although this memo presents only very preliminary analysis of the analytical issues that arise in targeting repo rates, a few general observations are worth highlighting.

- Repo rate targeting is a feasible option available to policymakers. There do not appear to be any operational challenges associated with targeting a repo rate that are beyond the staff's ability to work through over time. Policymakers would be able to choose from several implementation approaches, each likely to provide adequate control over the repo rate.
- The Federal Reserve likely could target repo rates effectively using standard monetary policy tools. In the current system based on the settings of administered rates, overnight repo rates have fluctuated more than the effective federal funds rate (EFFR), but have nevertheless consistently stayed in the target range for the federal funds rate, suggesting that a system closely resembling the one now in place could provide adequate control over the repo rate.

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<sup>3</sup> Although not discussed in this memo, in principle, the Federal Reserve could target repo rates by focusing on demand and supply conditions in the reserve market and adjusting the supply of reserves which affects the EFFR and through arbitrage between markets keeps the repo rate at the desired level. This would be an indirect way of operationalizing a repo policy rate that might nevertheless provide adequate control over the repo rate.

<sup>4</sup> In the following analysis, we use "demand" to describe cash borrowers and "supply" to describe lenders of cash.

- The FOMC could face some tradeoffs between the volatility of the market repo rate and the frequency and size of Federal Reserve operations necessary to stabilize the rate. Very tight control of the repo rate in some cases could require very active use of “fine-tuning” open market operations. On the other hand, if policymakers are willing to accept some degree of daily variation of the repo rate, including expressing the target rate as a range potentially supported by standing open market operation (OMO) facilities, then the need for the Desk to initiate frequent and sizable open market operations would likely be reduced. This tradeoff between the desired precision of rate control and the frequency and size of operations required to achieve that precision is broadly similar to the one the FOMC could face with an unsecured rate target.
- There are important linkages between the repo market and the reserve market. The setting of the IOER rate, for example, can affect lenders’ incentives to provide repo financing. Conversely, Federal Reserve repo operations undertaken to stabilize the repo rate can have spillover effects in unsecured markets. Some of these effects could likely be mitigated if a repo rate targeting regime is coupled with a relatively abundant supply of reserves under which the unsecured bank funding rate would trade close to IOER.

The remainder of this memo is organized as follows. Section 2 below develops a very simple supply and demand framework for the repo market. Using this basic framework, section 3 describes how the Federal Reserve could employ various mechanisms to help manage the level of the repo rate. Section 4 offers some general observations regarding repo rate targeting regimes. Section 5 concludes with a preliminary look at some of the institutional factors affecting demand and supply conditions in the repo market and the observed behavior of market repo rates.

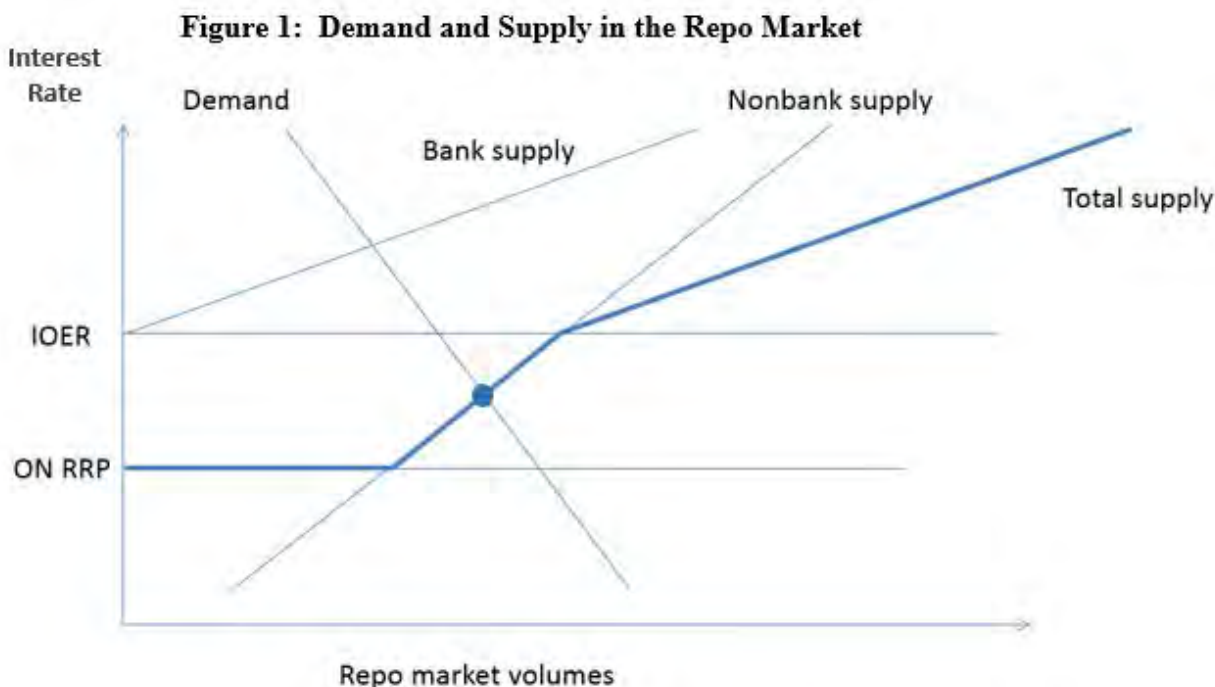
## 2 Demand and Supply in the Repo Market

As noted above, the Federal Reserve can influence the level of overnight repo rates through its standard tools, such as IOER, discretionary OMOs, and standing OMOs, that affect the demand and supply conditions in the repo market. The discussion below presents a stylized framework that is helpful in analyzing how various approaches to targeting the repo rate could work. In this approach, the repo rate is viewed as determined in a market in which the “demand” for repo

financing is driven largely by dealers that are financing or borrowing against inventories to meet customer needs. The private “supply” of repo financing is driven by the behavior of institutional investors such as non-bank money market mutual funds (MMFs) that seek to invest funds in short-term overnight instruments.

### 2.1 A Simple Analytical Framework

Figure 1 presents a stylized textbook framework that helps illustrate the market mechanics in the repo market when there is an ON RRP facility. The demand curve is downward sloping based on the assumption that dealers will be willing to hold larger inventories of securities if financing costs are lower. As discussed in more detail below, various factors could influence the demand for financing in the repo market, including exogenous changes in dealer repo inventories resulting from market making activity for customers and supporting new issuance of Treasury securities.



The supply side of the repo market, currently dominated by nonbanks, is shown as a function of the spread between the market repo rate and the ON RRP offering rate. Since nonbanks can deposit their funds at the Fed at the ON RRP offering rate, their supply curve does not fall below this rate. For banks to participate, the repo rate would have to rise above IOER. That is, no bank

should be willing to lend in the repo market at a rate below the rate they can earn on balances in their reserve account.<sup>5</sup> Above the IOER rate, the total funds supplied would be the horizontal sum of the supply curves for banks and nonbanks.

Given the assumed spread between the IOER rate and the ON RRP offering rate, and the assumed position of the supply and demand curves, the equilibrium repo rate in the diagram (denoted by the blue dot) is such that only nonbanks supply funds.<sup>6</sup>

The charts below illustrate the effects of demand and supply shocks on the equilibrium repo rate and how the Federal Reserve could offset those effects by conducting OMOs to change the overall supply of repo investments. The shift from the blue supply curve to the red supply curve in figure 2 shows the case when private lenders in the repo market reduce the supply of financing available at any given repo rate. Absent any intervention from the Federal Reserve, this shock would push the equilibrium repo rate upward along the existing demand curve to the yellow dot. The Federal Reserve could extinguish this effect on the equilibrium repo rate by conducting discretionary repo operations in order to keep the repo rate at the target. In this case, the quantity of repo operations required would be given by the distance between the red and blue dots

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<sup>5</sup> The slope of banks' supply curve for repo will depend on whether reserves are abundant or scarce. If banks are operating on the flat (steep) portion of their reserve demand curve, then it might take a relatively small (large) increases in the repo rate above the IOER rate to induce banks to lend in the repo market.

<sup>6</sup> Take-up at the ON RRP facility is zero in this example. If the demand curve intersected the flat portion of the supply curve, then private demand for repo would be less than nonbank supply at the ON RRP offering rate, and the Fed would step in and borrow the additional nonbank funds to keep the market rate at the offering rate.

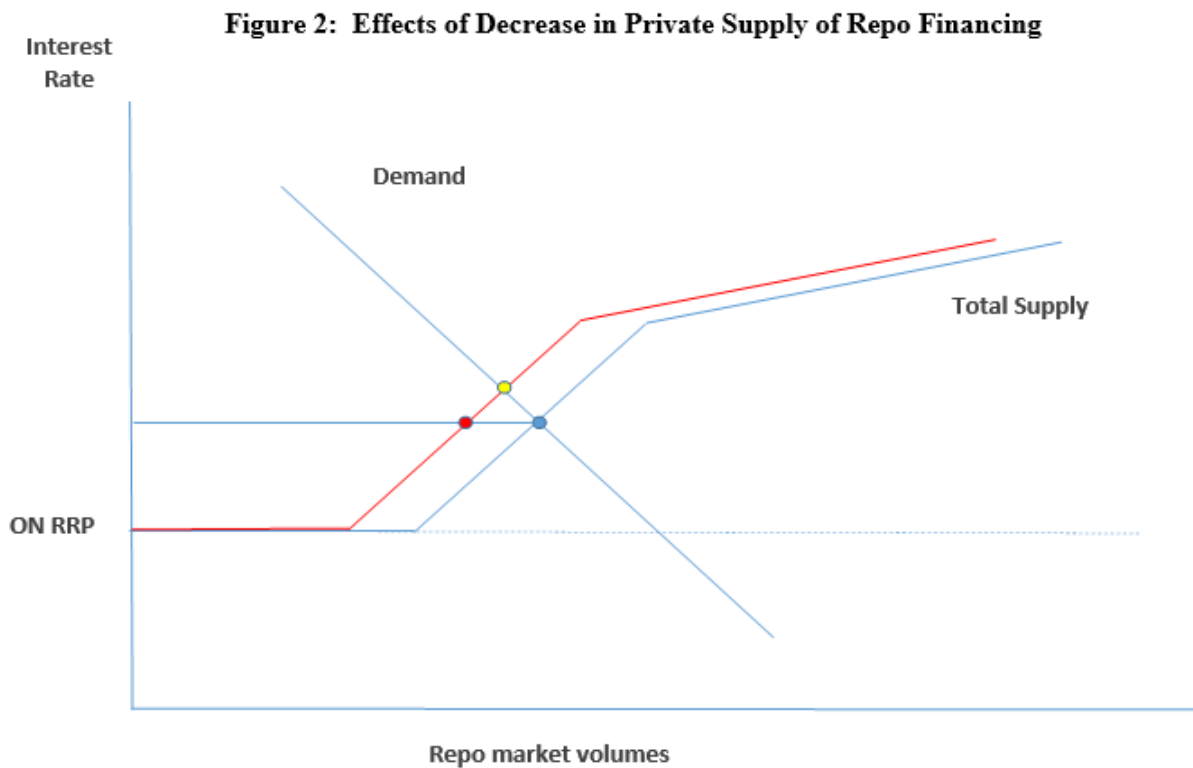
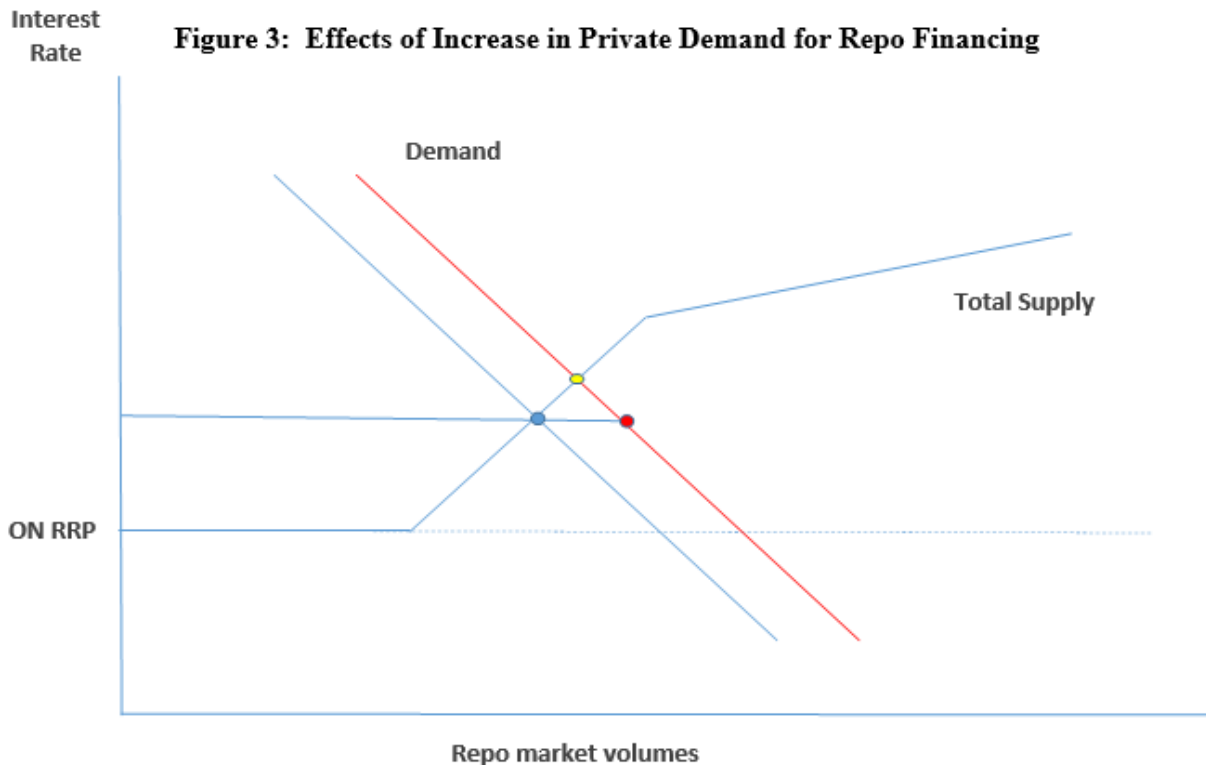


Figure 3 below shows the case when there is an exogenous increase in the demand for repo financing. In this case, the demand curve shifts to the right as illustrated by the shift from the blue to the red line. Absent any operations from the Federal Reserve, the equilibrium repo rate would be pushed up along the existing repo supply curve to the yellow dot. The Federal Reserve could extinguish this effect on market rates by conducting overnight repurchase operations in an amount shown by the distance from the blue to the red dots.



Similar analysis for the counterparts of figures 2 and 3 in the cases in which the supply curve shifts to the right or the demand curve shifts to the left indicates that the equilibrium repo rate would tend to fall. However, as in figures 2 and 3, the Federal Reserve could offset the effects of these shifts on the equilibrium repo rates by conducting open market operations, this time in the form of overnight reverse repurchase operations. Similarly, in all cases, adjustments to offering rates on the ON RRP or the IOER could also be used to move the supply curves in ways that would achieve the desired equilibrium, possibly with smaller changes in the balance sheet.

### 3 Alternative Mechanisms for Interest Rate Control

The supply and demand framework above suggests that the Federal Reserve can stabilize the repo rate through appropriate open market operations. A number of mechanisms have been proposed that would define how operations are conducted. Below we describe four possibilities that have been widely discussed—judgmental open market operations based on daily supply and demand estimates, standing repo and reverse repo operations at rates that establish a corridor around the target repo rate, standing repo and reverse repo operations at the target rate, and

standing repo and reverse repo operations at the target rate up to a predetermined quantity (the so-called TARALAC facility). In general, these approaches differ in the degree of interest rate volatility that is tolerated and whether the Federal Reserve or the market decides on the appropriate size of the RP or RRP operations.

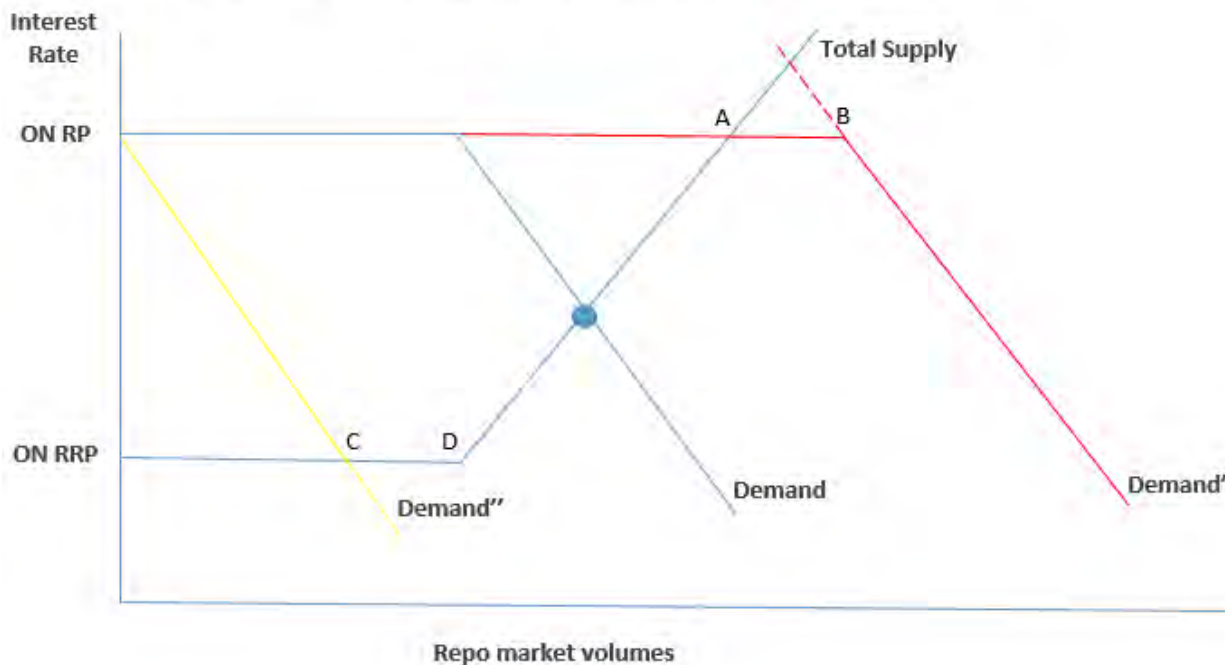
- *Judgmental Operations without standing facilities:* The operations necessary to target a particular level of the repo rate could be conducted on a judgmental basis. In this approach, the Federal Reserve could develop daily estimates of the demand and supply of repo financing and conduct operations necessary to meet any projected gap between demand and supply at the target repo rate. Such operations could be conducted multiple times each day if necessary<sup>7</sup>. In effect, the Federal Reserve would be acting as described in figures 2 and 3 above. As discussed in more detail below, developing reasonably accurate estimates of the private demand and supply of repo financing seems feasible. Moreover, the magnitude of operations required to stabilize repo rates may not be particularly large, at least in normal times.
- *Standing ON RP and ON RRP Facilities:* As discussed in the memo presented in the July FOMC meeting on international frameworks, a standard mechanism employed in targeting rates is to establish standing borrowing and lending facilities around the target rates. This approach could also be used by the Committee to set a target range for the repo rate with the ON RP and ON RRP offering rates set at the endpoints of the range. Alternately, the FOMC could allow the Desk some discretion to move the offering rates within some range to respond to perceived changes in the supply and demand for repo investments. The interaction of private demand and supply curves with standing facilities is shown in figure 4 below.

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<sup>7</sup> When targeting the federal funds rate pre-crisis with low levels of excess reserves, the Desk conducted an open market operation in the morning and would not know the extent of market clearing dynamics until between 5:00 and 6:00 pm as the market was closing and banks were settling their end of day positions. At that time, securities and repo markets were closed making it impossible to do any late day transactions to adjust the final supply of balances. For the repo market, which closes earlier in the day, it is possible that the Fed could be directly engaged in arranging clean-up operations late in the session to better target supply in this market. This could improve the daily settlement dynamics relative to what was experienced in the pre-crisis regime.



**Figure 4: Standing ON RP and ON RRP Facilities**



In the diagram, a standing ON RP facility provides financing whenever the repo rate rises above the ON RP rate. As a result, the ON RP facility establishes an upper bound on the repo rate. For a very large increase in repo demand, depicted by the red curve, the equilibrium repo rate (absent Federal Reserve operations) could be pushed above the ON RP. The standing ON RP facility would provide financing in this case equal to the segment AB that will fill the gap between private demand and supply and the ON RP rate maintaining the market clearing rate at the level of the ON RP facility. Conversely, if private demand were to drop sharply as shown by the yellow line, the equilibrium repo rate (absent Federal Reserve operations) could fall below the ON RRP rate. In this case, the Federal Reserve would borrow an amount equal to the line segment labelled CD to fill the gap between private demand and private supply at the ON RRP rate, maintaining the market clearing rate at the level of the ON RRP facility rate. For smaller shifts in the supply or demand curve that maintain an equilibrium rate between the two administered rates, the market rate would simply vary within the range.

- *Standing Operations at the Target Rate:* Another type of framework that could be used to target the repo rate is to simply stand ready to meet any demand for overnight financing or repo investments at the target repo rate. In this case, shifts in the private demand and supply

curves shown above would be “automatically” addressed by standing overnight and reverse operations at the target rate. This type of system would likely be quite effective in stabilizing the repo rate but could imply a fairly central role for the Federal Reserve in the repo market, potentially including operations on both sides of the market on the same day.

- *TARALAC Facility*: A related type of framework is the Target Rate-Limited Access (TARALAC) facility described recently by Ulrich Bindseil at the Jackson Hole conference. In a TARALAC facility, the Federal Reserve would again stand ready to conduct overnight repo lending and borrowing operations, as necessary, at the target repo rate. However, the quantity of such operations would be limited. In this case, a sufficiently large shift in private demand or supply could push the repo rate above or below the target rate. Of course, the TARALAC facility could be bundled with discretionary OMOs or could be bundled with standing RP and RRP facilities (at less attractive rates and larger caps) to dampen the effects of large demand and supply shocks. More details of how the TARALAC facility can affect market rates are discussed in the appendix.

## 4 Observations

While the framework described above is simplistic in many dimensions, it does highlight some of the basic issues that could arise in repo rate targeting and linkages to conditions in the banking sector.

**Rates and Quantities:** One observation is that the inherent volatility in the equilibrium repo rate (in the absence of Federal Reserve operations) and equilibrium level of repo financing would be importantly affected by the slopes of the private supply and demand curves. If the demand curve is relatively steep, any given increase or decrease in private supply will show through as a relatively large effect on the equilibrium repo rate but a relatively small effect on the equilibrium quantity of repo financing. Thus, when the demand curve is steep, the size of Federal Reserve operations necessary to dampen such effects on the repo rate would be relatively small. Conversely, if the supply curve is relatively steep, any given shift in the demand curve will imply a relatively large move in the equilibrium repo rate and a relatively small change in the equilibrium quantity of repo financing. Again, in this case, the magnitude of Federal Reserve

operations necessary to counter these shifts in demand and supply through open market operations would be relatively modest.

The mirror image cases arise when the demand and supply curves are relatively flat. If the demand curve is relatively flat, then any given upward shift in the supply curve will generate a relatively small increase in the equilibrium repo rate and a relatively large decline in the equilibrium quantity of repo financing. Similarly, when the supply curve is very flat, any given increase in the demand for repo will elicit a relatively small response in the equilibrium repo rate and a relatively large response the equilibrium quantity of repo financing.

In considering a regime like this, it would be important to gain some understanding of the factors affecting the slope of both the supply and demand curves in these markets. For example, if the level of reserves or the levels of administered rates affected the slope of these curves, it would complicate the simple analytical framework laid out above.

**Connections with the Unsecured Market:** The analysis above highlights some of the potential interactions between a repo rate targeting regime and conditions in the unsecured market. One type of connection is illustrated by the repo supply curve shown in figure 1. In that diagram, banks' willingness to supply financing in the repo market is heavily influenced by the level of the IOER rate relative to repo rates. If IOER is set well above the target repo rate, as it currently is, then banks will not ordinarily provide large amounts of financing in the repo market, consistent with current behavior. In this case, the setting of IOER effectively removes bank participation in the repo market.

Another connection can be illustrated by an example. In cases when the Federal Reserve is providing repo financing, there will be a corresponding increase in the quantity of reserves. This increase in reserves could then put downward pressure on the federal funds rate and other bank funding rates. The opposite situation would occur when the Federal Reserve conducts RRP operations to target the repo rate. In this case, other things equal, the supply of reserves would fall and there could be some degree of upward pressure on the federal funds rate and other bank funding rates.

These types of feedback effects on unsecured rates may need to be accounted for in the operating regime. An increase in reserve supply from a repo facility, for example, could be offset through term deposit operations or an adjustment to the level SOMA holdings. Alternatively, if the Federal Reserve operated with a floor system in the reserve market, marginal changes in reserve supply stemming from Federal Reserve repo operations would likely have only muted effects on bank funding rates. The Committee may also feel that some volatility in the unsecured market rate can be tolerated, especially if it is transitory. In the pre-crisis regime, the EFFR was kept very close to its target and the repo rate was allowed to fluctuate freely, with repo rates typically trading close to the federal funds rate.

## 5 Some Empirical Evidence on Demand and Supply Conditions in the Repo Market

The discussion above highlights that repo rate targeting is a feasible option available to the Committee, and it does not appear that there are operational challenges that are beyond the staff's ability to work through over time. That said, there are several aspects of private demand and supply that may be useful to consider. This section provides some empirical background on the institutional and environmental factors affecting supply and demand conditions in the repo market and how those conditions are reflected in observed market repo rates.

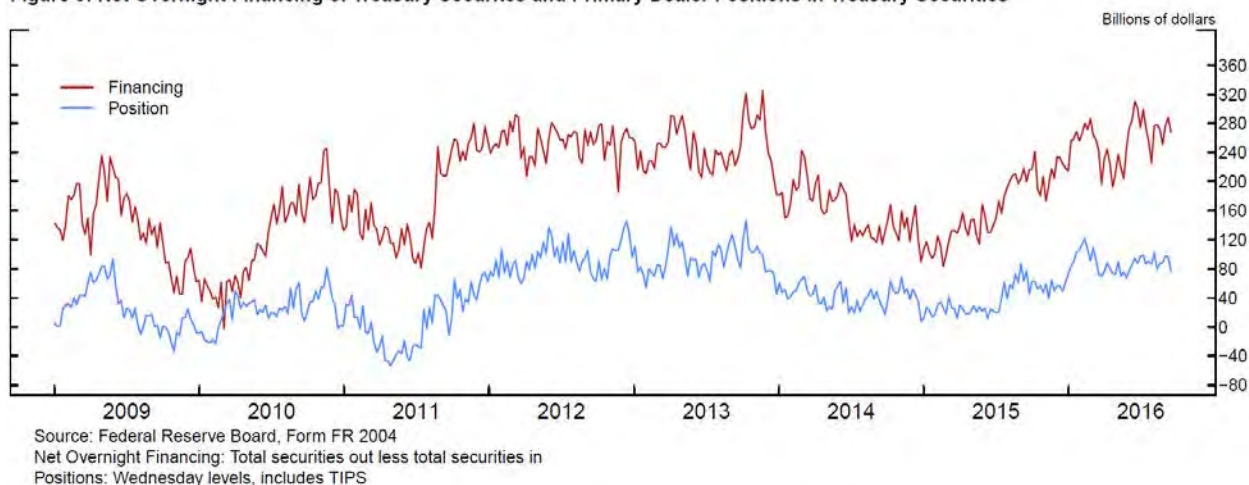
### 5.1 Demand for Financing

Borrowing in the repo market is largely driven by dealers in Treasury securities. Dealer financing demand stems from the need to fund awards from periodic Treasury auctions, to maintain trading inventories, and to provide intermediation services to their clients who are active in Treasury markets, such as hedge funds or foreign central banks. One marked feature of the repo market since 2014 has been that dealers' willingness to maintain sizable inventories and borrow in the repo market depends in large part on their perceptions of balance sheet availability within the context of capital regulations.

Figure 5 displays net primary dealer financing in the repo market. Dealers have expanded their repo financing activity since 2014 (red line). Some of that financing activity is driven by the

evolution of their outright positions in Treasury securities (blue line). In addition to the factors already mentioned, these positions are also affected by the willingness of dealers to assume proprietary positions to manage interest rate risk.

Figure 5: Net Overnight Financing of Treasury Securities and Primary Dealer Positions in Treasury Securities



While changes in dealers’ financing needs from Treasury issuance are regular and generally predictable, other changes in dealers’ holdings of Treasury securities could be less predictable. Dealer intermediation on behalf of hedge funds, for example, likely varies with yield curve expectations. Foreign central bank efforts to influence exchange rates are often supported by buying or selling Treasuries which can lead to large changes in dealers’ holdings of Treasury securities. Concerns about regulatory capital requirements reportedly led to declines in repo trading in 2014 but those concerns have abated some starting in 2015, suggesting that dealer responses to regulatory requirements are still evolving.

## 5.2 Supply of Repo Financing

A broad range of entities provide repo financing. The elasticity of supply is likely to depend on the various motives for different classes of firms to lend in short-term repo. Government-only MMFs, for example, are highly restricted in terms of the investments they can make and, as a result, hold large volumes of Treasury repos. However, other asset managers may have choices that range from low-risk Treasury securities to uninsured deposits at banks. And while repo

demand from, say, pension funds may be relatively stable and predictable, other entities such as MMFs and sec lenders may exhibit less predictable repo market investment behavior.

<b>Preliminary Estimates of Triparty Overnight Treasury Market Participation</b>				
<b>Lender Type</b>	<b>Typical Motivation</b>	<b>Share (%)</b>	<b>Borrower</b>	<b>Share (%)</b>
Mutual Fund	Investment	58.0	Primary Dealers	82.5
Asset Manager	Investment/Cash Management	9.9	Non-Primary Dealers	17.5
Custodial Bank	Arbitrage	7.1		
GSE	Cash Management	5.6		
Pension Fund	Cash Management	4.4		
Sec Lender	Arbitrage	4.0		
Primary Dealer	Arbitrage	3.8		
Municipality	Cash Management	2.9		
Bank	Customer Accommodation	1.3		
Clearing Bank	Cash Management	1.3		
Insurance Company	Cash Management	0.7		
Foreign Official	Investment	0.1		
Corporation	Cash Management	0.1		

That said, total overnight repo lending, shown in figure 6, has been fairly stable over time. As with dealer repo financing needs, the week to week volatility in the level of total repo lending is not particularly large. The average absolute weekly change over the period shown is \$13 billion and the maximum absolute weekly change, which occurred around 2014 year end, is \$72 billion.

Figure 6: Triparty Treasury Volumes

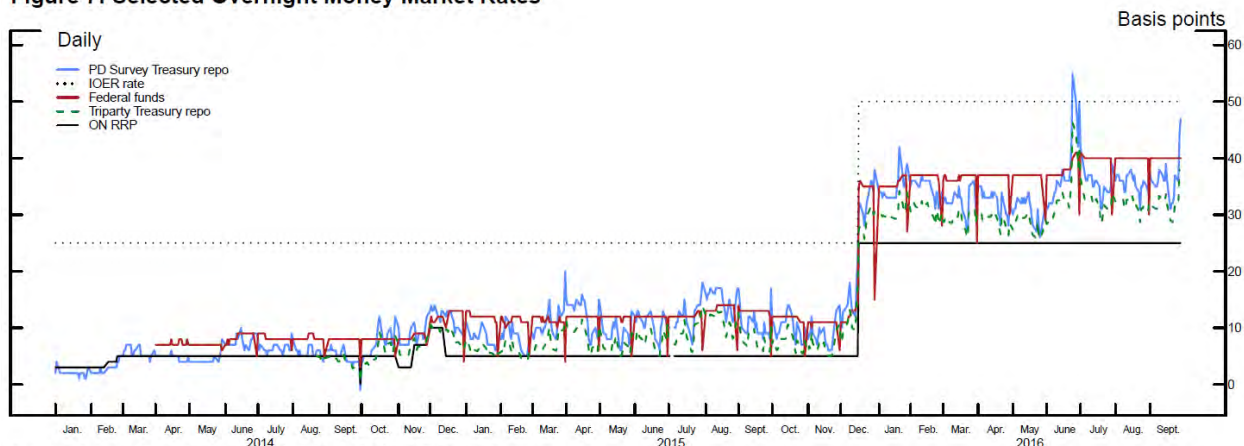


### 5.3 Equilibrium Repo Rate

Figure 7 shows two repo rates—the tri-party GC repo rate and the primary dealer survey rate—since the beginning of 2014 as well as the EFR.<sup>8</sup> These two rates have moved together closely, generally hovering 5 to 15 basis points above the ON RRP rate. Importantly, the ON RRP rate has established a firm floor on both measures of the repo rate. Absent any facility to cap the level of the repo rate, there has been one case in which repo rates have moved noticeably higher—the period in June of this year just ahead of the Brexit vote. At that time, many lenders wished to reduce their exposures to financial firms and pulled back from lending in the repo market. Roughly speaking, this might be viewed as corresponding to the case shown in figure 2 above.

<sup>8</sup> Recall that ON RRP began in September 2013. ON RRP parameters and learning by participants, however, probably limit the relevant ON RRP period to 2014 and later (prior to December 23, 2013, individual fund caps limited meaningful participation).

**Figure 7: Selected Overnight Money Market Rates**



Source: Federal Reserve Bank of New York; Federal Reserve Board.

The figure above illustrates one of the observations noted above about a repo rate targeting regime: The need for Desk discretionary operations would depend on the FOMC's tolerance for fluctuations in the policy rate. If the Committee were comfortable with letting the repo rate fluctuate in a 25 bps range, discretionary operations could be quite rare. If, in contrast, the FOMC desired to target a specific rate, then the Desk would need to take steps to dampen recent levels of volatility. As described above, the magnitude of the open market operations necessary to maintain the target repo rate is a function of the elasticities of the supply and demand curves. Very "flat" curves will tend to require relatively large operations to tightly control the repo rate while relatively steep curves would imply only small sized operations to target the repo rate.

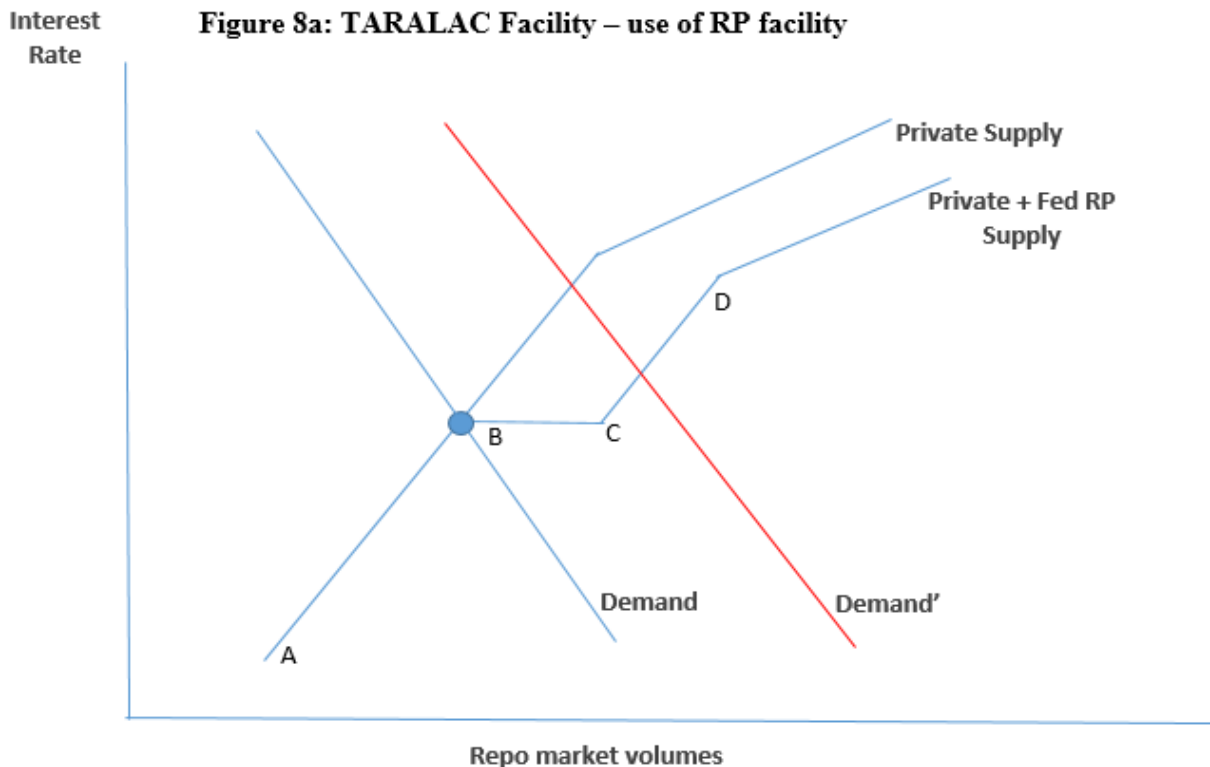
Additional work would be beneficial before one could confidently assess the behavior of the supply and demand curves in the market as well as the effect that changing the RP and RRP offering rates would have on private market rates in a dynamic setting. The relatively modest weekly variation in equilibrium quantities and rates in the market suggests that the demand and supply curves are reasonably stable over time and not especially steep or flat.



## Appendix – TARALAC Facility

As noted in the main text, an operating regime could include a Target Rate-Limited Access facility where the Federal Reserve would stand ready to conduct overnight repo lending and borrowing operations, as necessary, at the target repo rate in limited quantity. In this case, for sufficiently small shifts in supply or demand, the facilities will anchor market repo rates at the target. However, for sufficiently large shift in private demand or supply, the TARALAC will dampen the movement in the market repo rate, but it will move above or below the target. The following figures show how the TARALAC would work in these cases.

Figure 8a illustrates how the TARALAC facility might be established with an upper limit on the quantity of repo financing that the Federal Reserve is willing to supply. In this case, the effective total supply of repo financing available to the market (private plus Federal Reserve) is given by the line segments connecting the points ABCD. For relatively modest shifts in the demand curve, the equilibrium rate would be determined at the target rate along the flat segment of the supply curve BC. For larger shifts in the demand curve (shown by the red line), the quantity constraint on Federal Reserve repo lending (BC) would be binding, and the equilibrium repo rate would be determined along the CD segment of the repo supply curve. The resulting market repo rate would lie above the ON RP offering rate but to a lesser extent than if there was no facility.



Similarly, figure 8b illustrates how the TARALAC facility might be established with an upper limit on the quantity of repo borrowing that the Federal Reserve is willing to do. For relatively small shifts to the left in private demand for repo financing, the Federal Reserve would fill in the gap between private demand and supply and the equilibrium repo rate would be determined along the flat portion of the total repo demand for financing (private plus Federal Reserve). For larger shifts to the left in the private demand of repo financing, as shown by the yellow line EFGH, the quantity available from the Fed (FG) will not be sufficient to fill the gap between private demand and supply at the target rate. In this case, the equilibrium rate could be determined along the GH portion of the total demand for financing curve. Here the market repo rate lies below the ON RRP offering rate but to a lesser extent than if there was no facility.

