

July 13, 2016

## Money Markets<sup>1</sup>

### I. Introduction

The set of short-term wholesale funding markets collectively referred to as “money markets” have long been a focus of monetary policymakers and were at the center of many of the problems that arose in the financial crisis. Money markets are a key link in monetary policy transmission and collectively help determine short-term interest rates. Resilient wholesale funding markets with appropriate pricing of counterparty and idiosyncratic liquidity risk have been a key goal of much of the regulatory and supervisory reaction to the crisis. Since the crisis, significant changes in the Federal Reserve’s monetary policy implementation framework, changes in business practices, and new regulations have left an imprint on U.S. money markets.<sup>2</sup> We discuss broad developments in money markets from theoretical, empirical, and market participants’ perspectives. Our key findings are:

- Before the crisis, money markets operated in a way that made it fairly easy for the Federal Reserve to implement monetary policy using temporary repo operations to keep the federal funds rate close to its target.
  - But, many market participants used instruments traded in money markets to take excessive risks as liquidity and counterparty risk was not appropriately priced.
- During the crisis, the Federal Reserve expanded its balance sheet greatly. Reserves became abundant and banks no longer needed to trade in the federal funds market to meet reserve requirements. As a result, the federal funds market changed its character, although the federal funds rate remains linked to other money market rates and responds to changes in administered rates, such as the IOER rate.
- Since the crisis, a global regulatory reform program has put in place new regulations to limit imprudent risk-taking in money markets.
  - Due to the expanded Fed balance sheet, regulatory reform and changes in business models, relationships between central bank administered rates and money market rates, and among money market rates themselves are shifting. Money market rates at high frequencies may be somewhat less

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<sup>2</sup> We limit our discussion of offshore markets to Eurodollars; a more complete discussion of offshore dollar funding markets would include FX swaps and related instruments.

tightly connected than in the past. In part, that may stem from regulatory reforms that have made financial institutions less willing to expand their balance sheet or assume risk to capture relatively modest yield differentials across money markets.

- The new regulatory environment along with changes in business models are factors that will likely have implications for various design elements of the monetary policy operating framework that best achieves the FOMC's monetary policy objectives.
  - Some important regulatory changes are not yet in place, and market participants may adjust their business models further in response to these and other developments.<sup>3</sup>
  - The monetary policy implementation framework can be designed to support and enhance the benefits of the new regulatory framework in fostering a more resilient financial system with the understanding that a central bank's implementation framework is a critical determinant of behavior in money markets.

The remainder of this memo is organized as follows. Section II provides an overview of the basic structure of money markets. Section III reviews the monetary policy implementation and regulatory frameworks prior to the crisis and the behavior of money markets in that era. Section IV discusses the evolution of money markets since the crisis in light of changes to the Federal Reserve implementation framework and regulations. Section V summarizes market participant views on the recent development in financial markets. Section VI concludes by discussing possible connections between the evolution of money markets and issues associated with the long-run operating framework.

## **II. Overview of the Structure of Money Markets**

Money market instruments are not new; markets in which borrowers seek very short-term funding have existed for centuries. The fundamental incentives for trading in such markets include a variety of factors shaping the demand and supply sides of the market. Borrowers may desire short-term funding to manage the cash flow and interest rate risk characteristics of their assets and liabilities. Similarly, lenders may seek a short-term store of value to match future obligations, or may wish to lend at only very short terms to constrain the potential actions of borrowers. For example, some have suggested that money market instruments can provide some monitoring benefits, acting as a source of market discipline for borrowers that undertake projects with uncertain return.<sup>4</sup>

Defined broadly, modern money markets include a range of markets for short-term borrowing and lending, with and without collateral; transactions in these markets

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<sup>3</sup> Two relevant changes not yet in place are new SEC regulations on institutional prime money market funds and the Basel III net stable funding ratio.

<sup>4</sup> Refer to Rochet, Jean-Charles and Jean Tirole (1996), "Interbank Lending and Systemic Risk," *Journal of Money, Credit and Banking*, vol. 28, no. 4, p. 733-762.

typically involve a variety of short-term (under one year), liquid instruments with little credit risk.<sup>5</sup> Money market instruments are so termed because they provide a liquid store of value that yields “monetary services.” This memo focuses on the markets for federal funds, Eurodollar, repo, Treasury bills, and commercial paper with maturities under three months. Federal funds and Eurodollar are unsecured bank borrowing markets; repo is a secured borrowing market; and commercial paper can be either unsecured or secured.

Tables 1 and 2 summarize data on money markets from the Financial Accounts. Depository institutions, broker-dealers, and money market mutual funds (MMMFs) are key financial intermediaries that transact in several money market instruments. For example, focusing on a subset of MMMF holdings, MMMFs collectively allocate roughly 20 percent of their total assets to repo, 12 percent to open market paper (including commercial paper), 37 percent to Treasury and agency securities, and 30 percent to other instruments. On the other side of many transactions are financial firms that seek short-term funding. Broker-dealers use repo to finance nearly half of their asset holdings. A repo transaction is legally structured as an asset sale with an agreement to repurchase but economically functions as a collateralized loan. Similarly, an institution might issue asset-backed commercial paper to fund a pool of assets, a bank might issue a CD to fund loans, and a bank holding company might issue commercial paper to downstream funds to its affiliates. Federal funds borrowers are depository institutions and the major lenders in recent years are predominantly GSEs (government-sponsored enterprises), and specifically, Federal Home Loan Banks (FHLBs).

The repo market largely intermediates between dealers and lenders such as MMMFs, GSEs, securities lenders, and hedge funds. Even across repo transactions, there are meaningful differences in contracts that are important for analyzing the behavior of rates. There are three categories of repo that differ in both the treatment of collateral and the platforms on which they are traded. In bilateral repo, borrowers and lenders transact directly and may exchange specific securities, whereas in general collateral (GC) repo, the cash lender accepts any collateral that falls into a general class of securities. GC repo transactions are negotiated based on term, rate, and underlying GC asset (e.g., U.S. Treasury, or Agency MBS). Tri-party repo is a GC repo transaction that is cleared and settled by a tri-party clearing bank. GC repo securities are held in the respective accounts of tri-party repo market participants at the tri-party bank rather than physically exchanged between counterparties. Finally, the General Collateral Finance (GCF) repo market is a blind brokered largely interdealer market for GC repo transactions. Dealers intermediate across the various GC repo markets, typically borrowing funds in the tri-party repo market from cash lenders, and then using the GCF repo market to manage any excess or

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<sup>5</sup> More specifically, the set of money market instruments includes federal funds and Eurodollars, various types of repo, U.S. Treasury bills, agency discount notes, unsecured and asset-backed commercial paper, and large negotiable time deposits. The major borrowers in these markets include depository institutions (DIs or banks) – both domestic banks as well as foreign banking organizations (FBOs) – broker-dealers, governments, and nonfinancial corporations. The major lenders in these markets include money market mutual funds (MMMFs), government-sponsored enterprises (GSEs), and securities lending programs. Historically, some entities – including GSEs, banks and broker-dealers – both borrow and lend in these markets.

shortfall of financing with other dealers. Dealers also intermediate by borrowing funds in tri-party and lending directly to hedge funds in the bilateral repo market.

Money market rates generally move together closely, as illustrated in Figure 1 by the high degree of correlation across rates on four main overnight instruments: brokered federal funds, brokered Eurodollars, U.S. Treasury repo (from the Desk's daily survey of Primary Dealers) and AA-rated financial commercial paper. Aside from September 11, 2001 and the crisis period of late 2007-2008, before the crisis repo and commercial paper rates were, on average, within 2 basis points of the daily effective federal funds rate, and the impact of changes in the target federal funds rate were immediate. That said, before the crisis, there may have been some opacity on the credit risk associated with some counterparties and instruments, and so spreads may have been too low. The crisis likely exposed some information on counterparties and instruments, leading to more appropriate pricing of risk.

Since the crisis, overnight rates have become less correlated at high frequencies, reflecting a range of factors including balance sheet costs, imperfect competition, and other frictions that affect major participants in the key markets. In addition, wider spreads are evident, even for the **same** instrument in different markets such as repo.<sup>6</sup> For example, as shown in Figure 2, the Treasury GCF and tri-party repo spread has widened considerably since 2014; pre-crisis, spreads between available measures of Treasury repo rates reportedly were only a couple of basis points.<sup>7</sup> Nonetheless, rates in the money market still exhibit a significant degree of co-movement at the frequencies relevant for transmission of the stance of monetary policy to broader markets. Lately, variability in the federal funds rate and Eurodollar rates has been minimal, even amid Brexit concerns.

While money market rates have remained connected post-crisis, the level and distribution of volumes across money markets instruments has changed substantially. For example, the dollar volume of primary dealer secured borrowing is currently roughly one-half of its peak 2007 level, as shown in Figure 3. The unprecedented level of excess reserves as well as the introduction of interest on excess reserves (IOER) in October 2008 are new factors influencing trading conditions in unsecured markets.<sup>8</sup> Because of the high level of excess reserve balances, banks typically do not need to borrow unsecured to meet reserve requirements. Instead, many banks (and foreign banking organizations (FBOs) in particular) borrow using an overnight unsecured instrument and park the proceeds in their reserve account, earning the spread between IOER and the unsecured borrowing rate.

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<sup>6</sup> Since some spreads may have been too low pre-crisis, the current widening may be more in accordance with the risk of the instrument. This may be particularly true for some types of commercial paper. Going forward, the widening of spreads in repo may reflect differences in counterparty type. Currently, however, and as will be explained below, the wider spread across some platforms likely in part reflects balance sheet costs.

<sup>7</sup> Data in the chart reflects transaction-based data; pre-crisis spread is calculated from survey-based information.

<sup>8</sup> Excess reserve balances are those bank deposits held at the Federal Reserve that exceed reserve balance requirements.

Absent some of the frictions noted above, this process would be expected to drive the level of overnight bank borrowing rate up to the level of IOER.

The introduction of the Federal Reserve's daily overnight reverse repurchase agreement (ON RRP) facility extended Federal Reserve repo transactions to money market participants beyond the set of primary dealers, which includes both bank and non-bank broker dealers, and created an additional direct linkage between FOMC policy actions and non-bank financial institutions. As shown in Figure 4, the introduction of the ON RRP appears to have reduced repo rate volatility.

Against this backdrop, a question arises as to what constitutes well-functioning money markets. For the purposes of this memo, there are probably a few key features of well-functioning money markets that are important to consider. First, the money market instrument should serve as a liquid store of value. That is, investors in money market instruments can be reasonably sure that the value of their investment is maintained. However, an instrument's liquid store of value is not independent of the central bank's policy of liquidity provision or the regulatory environment, which could include a backstop, especially during times of stress. Second, as described in the Foreign Experience memo, central banks around the world implement policy through policy actions affecting money markets. Hence, a well-functioning money market should permit a central bank to pursue its interest rate target in a way that achieves its policy objectives. But the ability of the central bank to successfully achieve these objectives depends on the monetary policy implementation framework and the regulatory environment. As a result, it is difficult to describe a well-functioning money market that is independent of the monetary policy implementation framework or the regulatory environment.

### **III. Behavior of Money Markets Before the Crisis**

This section describes the pre-crisis monetary policy and regulatory frameworks and discusses money market outcomes, such as rates, volumes, and the degree of money market arbitrage during this period.

#### *The Pre-Crisis Monetary Policy Implementation Framework*

Before 2007, the Federal Reserve's policy framework could be described as an asymmetric "corridor" system, with a loose "ceiling" or upper bound provided by the primary credit rate, a "floor" or lower bound at zero, and a point target for the policy rate. In this system, the Federal Reserve provided substantial intraday credit and supplied a level of reserve balances that just satisfied the demand for reserve balances (to meet reserve requirements and for other needs) at the target federal funds rate set by the Committee.<sup>9</sup> Banks were able to obtain additional reserves in the federal funds market,

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<sup>9</sup> Average peak daylight overdrafts provided by the Federal Reserve was roughly \$140 billion in 2006.

where daily trading volumes were many multiples the level of reserve balances.<sup>10</sup> Much activity in the federal funds market was between banks with surplus reserves selling federal funds to banks needing reserves to meet reserve requirements or to cover payments needs. Other banks “made markets” by arbitraging expected changes in the intraday federal funds rate.

With reserve balances unremunerated, holding reserves was costly, so banks actively managed reserve levels to meet requirements with only a small amount of excess balances and took steps to reduce reserve requirements through sweep accounts and other means.<sup>11,12</sup> From 2003 to 2007, reserve balances averaged only about \$11 billion and excess reserve balances were only about \$2 billion.

The Desk performed open market operations to supply reserve balances at a level to put the daily effective federal funds rate (EFFR) at or very close to the target rate, mainly using temporary operations such as repo.<sup>13,14</sup> These operations were sized to offset changes in autonomous factors, such as currency, check float, and balances in the Treasury General Account, as well as to provide balances in line with the forecasted demand for excess reserve balances. The Desk used an auction mechanism to arrange repos with the primary dealers; its intention was not to change repo rates, but rather, to adjust reserve balances so that the federal funds rate would trade near the target.<sup>15</sup> Operations were generally small; temporary open market operations (OMOs) via repo averaged about \$4.7 billion from 2000 to 2006 per day relative to dealer Treasury repo borrowing volume measured by the Desk survey of roughly \$300 billion.<sup>16</sup> Permanent open market operations (purchases of Treasury bills or coupon securities undertaken mostly to accommodate growth in currency in circulation) were infrequent and typically smaller, averaging about \$1 billion per auction.

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<sup>10</sup> Specifically, fed funds purchases were roughly \$300 billion, while reserve balances were about \$20 billion.

<sup>11</sup> Contractual clearing balances were remunerated at a below-market rate in the form of credits to pay for Federal Reserve services.

<sup>12</sup> There were plans to alter the framework prior to the financial crisis. In particular, Congress passed legislation enabling the Federal Reserve to pay interest on required and excess reserve balances partly to eliminate the tax on holding reserve balances. In addition, interest on excess reserves (IOER) was intended to enhance the Federal Reserve’s interest rate control under unusual circumstances. In particular, the IOER rate was expected to be a floor under money market rates if reserve balances became unexpectedly abundant. Refer to “[Interest on Reserves: A Preliminary Analysis of Basic Options](#),” April 2008 memo to the FOMC.

<sup>13</sup> The daily effective federal funds rate was the volume-weighted average rate on federal funds trades arranged by major brokers.

<sup>14</sup> Overnight repos were conducted on 67 percent of business days. Including term operations, repos were conducted on 85 percent of business days. Other jurisdictions, such as the ECB, operated less frequently.

<sup>15</sup> These were multiple price auctions with a stop-out rate at the lowest bid. Of course, the Federal Reserve adjusted its policy stance to alter money market and other interest rates, which we distinguish from rate effects stemming from implementing the policy, such as pricing effects in the repo market or the secondary market for Treasury securities.

<sup>16</sup> The Desk also executed temporary open market operations in agency debt and agency MBS. In 2006, dealer volumes averaged \$176 billion in agency debt and \$250 billion in agency MBS.

### *Pre-Crisis Behavior of Money Markets*

In general, the federal funds rate stayed close to the target federal funds rate prior to the crisis. The mean absolute deviation of the daily effective federal funds rate from the target was about 5 basis points from 2001 to 2005. The available evidence, though limited, indicates that rates on federal funds sold by GSEs and banks tended to be similar in the pre-crisis period.<sup>17</sup> That said, foreign banks often paid higher rates than domestic banks to buy fed funds, particularly during times of stress. There were also distinct intra-maintenance-period patterns for rates in the federal funds market.<sup>18</sup> These were related in part to the averaging of reserve positions over the maintenance period and to the need to satisfy requirements on the last day of the maintenance period. Furthermore, trading on any given day could occur within a range of rates around the target, the high-low spread was about 55 basis points from 2001 to 2006, based in part on variations in the distribution of reserve balances across banks as well as differences in credit quality or size of borrowing institution. However, the average interquartile range of trading was within 5 basis points of the target rate. Intraday volatility typically was higher on the last day of the maintenance period, reflecting squaring of reserve positions to satisfy requirements.

Federal funds market outcomes under the pre-crisis monetary policy implementation framework can be understood in the context of standard models of reserve management.<sup>19</sup> Banks appeared to interact in a competitive market for federal funds, and levels of reserve balances in excess of banks' demand at the target rate led to federal funds trading below the target rate; and vice versa. Some banks sold while others bought funds, and still others did both. GSEs, including Fannie Mae, Freddie Mac, and the FHLBs, tended to be only sellers. The primary credit rate was intended to act as a rate ceiling on federal funds trades, but, perhaps because of stigma associated with borrowing at the window, federal funds sometimes traded at rates above the primary credit rate.

Pre-crisis, other money market rates generally tracked the federal funds rate. In particular, available measures of the overnight Eurodollar rate suggested it moved closely with the federal funds rate. In addition, Treasury GC repo rates as well as repo using agency debt and agency MBS moved with other money market rates. Longer-term

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<sup>17</sup> According to the FHLBs' 2006 annual report, the average rate earned on federal funds transactions was 5.03 percent; the average effective federal funds rate for that year was 4.96 percent. FHLBs had an average balance of \$69 billion outstanding in federal funds that year; brokered federal funds volume hovered around \$150 billion and Call report federal funds purchased for domestic commercial banks was roughly \$250 billion. In 2010, a back-of-the-envelope calculation suggests that FHLBs earned roughly the average federal funds rate that year of 19 basis points. Refer to [http://www.fhlb-of.com/ofweb\\_userWeb/resources/06yrend.pdf](http://www.fhlb-of.com/ofweb_userWeb/resources/06yrend.pdf); [http://www.fhlb-of.com/ofweb\\_userWeb/resources/10yrend.pdf](http://www.fhlb-of.com/ofweb_userWeb/resources/10yrend.pdf)

<sup>18</sup> Refer to Hamilton, James (1996), "The Daily Market for Federal Funds," *Journal of Political Economy*, vol. 104, no. 1, p. 26-56.

<sup>19</sup> Refer to Poole (1968), "Commercial Bank Reserve Management in a Stochastic Model: Implications for Monetary Policy," *Journal of Finance*, vol. 23, p. 769-91, and Ihrig, Meade and Weinbach (2016), "Rewriting Monetary Policy 101: What's the Fed's Preferred Post-Crisis Approach to Raising Interest Rates?" *Journal of Economic Perspectives*, vol. 29, no. 4, p. 177-98.

money market rates also followed the federal funds rate. For example, while the three-month Treasury bill rate averaged 15 basis points below the target federal funds rate from 2001 to 2006, much of the deviation reflected anticipated movements in the federal funds rate.<sup>20</sup>

From 2004 to 2006, changes in the target federal funds rate were generally expected by market participants. As a result, rates on term money market instruments would reflect these expectations as the FOMC meeting date approached. In addition, reflecting the averaging of reserve positions across the maintenance period, the federal funds rate and other overnight rates would drift in the direction of the expected rate change for a week or so before the actual release. When the target did change, overnight money market rates reflected the new target almost immediately. Consistent with this behavior, money market participants generally viewed the FOMC target rate as the anchor rate for many other money market rates. Indeed, arbitrage across money markets kept other money market rates in line with federal funds. As shown in Figure 1, other money market rates, generally tracked the EFFR. There were some variations in spreads between these rates.<sup>21</sup> For example, there were high frequency seasonal patterns in repo rates on days when auctions of Treasury securities settled; these seasonal patterns were roughly the same regardless of platform and the spread between the Treasury GCF repo rate and the Primary Dealer Treasury survey rate averaged about 2.5 basis points. Moreover, on a longer-horizon, Treasury bill (T-bill) rates tended to rise and fall with quantities outstanding.<sup>22</sup> In addition, federal funds, repo, commercial paper, and LIBOR all exhibited volatility on reporting dates such as quarter-ends and year-ends, when some swings exceeded 100 basis points.<sup>23</sup> Term federal funds and term repo were relatively more commonly used than today, and commercial paper was issued in an active market across a wide range of maturities.

Similar to the federal funds market, other money market volumes grew rapidly in the years before the crisis, a sign of the build-up of risks in the non-bank (or shadow banking) sector. The volume of dealer Treasury repo volume as reported by primary dealers on the FR2004 form rose from \$482 billion in July 2001 to \$1.2 trillion at the end of 2006.<sup>24</sup> Significantly, repo volumes for non-open market eligible collateral increased at rapid rates as money markets facilitated excessive maturity and liquidity transformation. For example, asset-backed commercial paper peaked at almost \$1.2

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<sup>20</sup> When the target rate stayed at 1 percent for a protracted period, the average deviation between the target federal funds rate and the three month bill rate was 4 basis points, suggesting a close relationship between these two rates.

<sup>21</sup> Refer to Kroeger and Sarkar (2016), “Monetary Policy Transmission before and after the Crisis,” Liberty Street Economics, available [here](#).

<sup>22</sup> Refer to Greenwood, Hanson and Stein (2015), “A Comparative Advantage Approach to Government Debt Maturity,” *Journal of Finance*, vol. 70, no. 4, p. 1238-1286.

<sup>23</sup> For example, refer to Downing and Oliner (2007), “The Term Structure of Commercial Paper Rates,” *Journal of Financial Economics*, vol. 83, no. 1, p. 59-86.

<sup>24</sup> Volume measures for Eurodollars comparable to current sources are unavailable pre-crisis; refer to [BIS international banking statistics](#) for a more general discussion of the Eurodollar market.



trillion in mid-2007.<sup>25</sup> The growth in money market instruments fueled a credit market boom that left the financial system over-leveraged and exposed to a system-wide “run on the bank.”<sup>26</sup> Overall, these increases in volumes may have been a missed sign of excess risk-taking that contributed to the financial crisis.

#### **IV. The Evolution of Money Markets Since the Crisis**

This section reviews notable changes in the Federal Reserve’s monetary policy implementation framework and in regulations that have affected money market activity.<sup>27</sup>

##### *Changes in the Framework for Policy Implementation*

After December 2008, the Federal Reserve’s framework for policy implementation effectively became a “floor system” with super-abundant reserves, albeit with a soft floor. The IOER rate exerts an influence on the level of short-term rates, but overnight money market rates typically have been below the IOER rate. As discussed in more detail below, the Federal Reserve developed new tools to support IOER in the implementation of monetary policy, particularly during the period of policy normalization.<sup>28</sup>

At the height of the financial crisis in October 2008, the demand at Federal Reserve credit and liquidity facilities caused reserve balances to surge, putting substantial downward pressure on the federal funds rate and making it difficult to achieve the target with the then-standard tools. Interest on required and excess reserves (IOER) was implemented at this time to establish a “floor” under the level of the federal funds rate.<sup>29</sup> The EFFR was expected to trade above the IOER rate but, as noted in the “Lessons from the Crisis” memo and discussed below, the funds rate often traded below IOER in the fall of 2008.<sup>30</sup> Importantly, only depository institutions earned IOER; other federal funds market lenders, including GSEs, were (and are) ineligible to earn interest on balances at the Federal Reserve.

After the most acute stage of the financial crisis began to ease, reserve balances continued to grow as the decline in reserves associated with the unwinding of various crisis-related facilities was more than offset by the increase in reserves created by asset

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<sup>25</sup> Refer to Covitz, Liang, and Suarez, 2013, “The Evolution of a Financial Crisis: Collapse of the Asset-Backed Commercial Paper Market,” *Journal of Finance*, Volume 68, Issue 3, p. 815–848.

<sup>26</sup> Refer to Pozsar, Adrian, Ashcraft, and Boesky, 2010, “Shadow Banking,” Federal Reserve Bank of New York Staff Report 458.

<sup>27</sup> We generally do not address money market outcomes during the acute stages of the crisis in this memo; for more information, please refer to the “Lessons from the Crisis” memo.

<sup>28</sup> See the appendix for a discussion of the historical evolution of the Federal Reserve’s monetary policy implementation framework.

<sup>29</sup> IOER was originally authorized to be implemented in October 2011; this date was accelerated to October 2008.

<sup>30</sup> It was generally not foreseen that the federal funds rate would trade below the IOER rate.

purchase programs.<sup>31</sup> By the end of 2008, the level of reserve balances had risen above \$750 billion, up more than \$700 billion from the year prior. Subsequently, reserve balances climbed to about \$3 trillion after successive waves of asset purchase programs.<sup>32</sup> “Fine-tuning” temporary OMOs ceased, as elevated reserve balances made movements in autonomous factors irrelevant for conditions in money markets.<sup>33</sup>

As the FOMC implemented asset purchase programs, it also considered its strategy for eventually implementing a normalization in the stance of monetary policy. In light of the experience during the fall of 2008 when IOER failed to act as a firm floor under the federal funds rate, the Federal Reserve sought additional tools that could work in concert with changes in IOER to raise the level of short-term rates when it became appropriate to do so.<sup>34</sup> The Federal Reserve developed new tools including the term deposit facility (TDF), term RRP, and ON RRP to support policy normalization. In addition, the set of Federal Reserve counterparties for reverse repurchase agreements was expanded to include MMMFs, as well as selected GSEs.<sup>35</sup> The ON RRP effectively extended a new benchmark rate—the ON RRP offered rate—to major nonbank lenders in the money markets (analogous to IOER for banks) that established a lower bound on the rate at which they were willing to lend to private counterparties.

#### *Changes in Regulatory Factors Affecting Money Markets*

The new suite of financial regulations directed at banks, nonbanks, and markets over the past six years have been promulgated to increase the safety and resiliency of the financial system. The financial crisis demonstrated that the largest financial institutions must hold higher and better quality capital and must reduce their reliance on unstable short-term wholesale funding. Reforms put in place since the crisis have contributed to improved financial stability by requiring banks to hold larger buffers of capital and liquidity. In particular, relative to the period prior to the crisis, these regulations should discourage heavy reliance on short-term funding and other risky asset-liability management practices. Moreover, large financial institutions must maintain capital buffers that are more commensurate with the risks they are assuming, both for themselves and for the overall financial system. The Federal Reserve has also transformed its supervision of the largest financial firms through the creation of the LISCC structure. The LISCC undertakes annual horizontal reviews of large firms’ capital planning and liquidity risk management, strengthening the incentives for financial institutions to better manage their

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<sup>31</sup> The central bank liquidity swaps generally wound down to low levels in the same manner as the other credit and lending programs. However, balances returned to somewhat higher levels during the strains in European markets witnessed in 2011 and 2012.

<sup>32</sup> Liabilities in excess of currency peaked at about \$3.2 trillion in 2014.

<sup>33</sup> In addition, the average peak daylight overdraft dropped considerably and over the past few years, has averaged less than \$10 billion per day.

<sup>34</sup> Reserve balances eventually peaked at \$2.9 trillion in December 2014.

<sup>35</sup> The process of expanding counterparties was initiated in 2009, with the intention of draining reserve balances using overnight or term reverse operations. Refer to [https://www.newyorkfed.org/markets/rrp\\_announcements.html](https://www.newyorkfed.org/markets/rrp_announcements.html) for the list of counterparties.

credit and liquidity risks. In addition, there have been changes to SEC regulation of MMMFs and the design of the FDIC premiums for deposit insurance.

These important reforms designed to increase the resiliency of the overall financial system but that also have a number of implications for money markets. In this section, we focus on regulatory changes that should have the greatest impact on money markets. These include the expanded FDIC assessment base, the supplementary leverage ratio (SLR), the liquidity coverage ratio (LCR), the net stable funding ratio (NSFR), and money market mutual fund (MMMF) reforms.<sup>36</sup>

In April 2011, the FDIC broadened the base for levying deposit insurance premiums from essentially all domestic deposits to average consolidated total assets less average tangible equity during the assessment period.<sup>37</sup> One intent of this change was to impose an insurance cost on large FDIC-insured banks that is more commensurate with the risk they pose to the system. The former base and the broader base for the FDIC fee applies to those institutions that hold insured deposits, which are domestic insured DIs, and generally not to branches and agencies of foreign banking organizations (FBOs).<sup>38</sup>

Subsequently, a suite of Basel III capital and liquidity regulations for banking institutions has begun to be phased in. Under the supplementary leverage ratio (SLR), large banking organizations must maintain a minimum ratio of capital to total leverage exposure of 3 percent.<sup>39</sup> The U.S. implementation of the SLR is more stringent than the international standard in several respects: in particular, it requires an extra 2 to 3 percentage point capital buffer for the very largest institutions and mandates that leverage exposures are measured at a daily frequency as opposed to a monthly or quarterly frequency as in some other jurisdictions.

Unlike risk-based capital requirements, the SLR is insensitive to credit quality and other risks, as capital must be held against all assets, including zero-risk assets important for monetary policy implementation, such as reserves and Treasuries, either held outright or as collateral against reverse repos.<sup>40</sup> Because the SLR is not risk-sensitive, it is intended to provide a backstop to risk-based capital requirements although it may be binding for some firms at certain points in time. As with the risk-based capital ratios, although this regulation becomes effective in the United States on January 1, 2018, nearly every U.S.-based global systemically important bank (G-SIB) already complies.<sup>41</sup>

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<sup>36</sup> Refer to “Money Markets: Regulations,” memo to Research Directors, July 13, 2016 for more information.

<sup>37</sup> The FDIC also amended the formula for calculating assessment rates to incorporate the size, complexity, and risk of the insured institution.

<sup>38</sup> The revised assessment base includes reserve balances held by insured depositories at Reserve Banks.

<sup>39</sup> Total leverage exposure is the sum of on-balance sheet assets and total off-balance sheet exposures, such as derivative and repo transactions.

<sup>40</sup> Zero risk as assessed under Basel III risk weights.

<sup>41</sup> Again, although these institutions are compliant, the SLR may not be the binding capital constraint.

The Liquidity Coverage Ratio (LCR) seeks to strengthen banks' liquidity positions by requiring them effectively to self-insure to a large extent against potential funding difficulties.<sup>42</sup> Banks must hold a minimum amount of unencumbered, high-quality liquid assets (HQLA), such as Treasury securities, Agency securities and excess reserve balances, to withstand net cash outflows over a 30-day "stress period," characterized by simultaneous idiosyncratic and market-wide shocks.<sup>43</sup> This regulation discourages short-term funding of long-term assets (under 30 days) relative to longer-term funding (greater than or equal to 30 days), reflecting differences in runoff rates applied to these borrowings.

Finally, the Federal Reserve, along with the other federal banking agencies, issued a proposed NSFR rule in May 2016.<sup>44</sup> The NSFR is intended to reduce the likelihood that disruptions to banks' funding sources will compromise banks' liquidity position. To mitigate the risk of funding stress over a one-year horizon, banks will be required to structure their liabilities to be consistent with the liquidity characteristics of their assets, derivatives, and commitments. This requirement should discourage excessive reliance on short-term wholesale funding and encourage better bank management of funding risk.

Of note, for the G-SIBs, the Comprehensive Capital Analysis and Review (CCAR) may in fact impose a more binding constraint than these regulations for the overall capital requirement. Specifically, the CCAR assesses whether the largest bank holding companies operating in the United States have sufficient capital to continue operations throughout times of economic and financial stress and that they have robust, forward-looking capital-planning processes that account for their unique risks. This could have implications for money markets, depending on whether money market exposures are among the adjustments taken to satisfy the CCAR.<sup>45</sup>

In addition to these bank regulations, the SEC has developed new regulations to reform MMMFs. A first set of such reforms, issued in 2010, established stricter liquidity, credit quality, disclosure, and maturity requirements for holdings. These changes are intended to better protect investors' shares by reducing the risk of investor runs and to make

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<sup>42</sup> Systemic funding difficulties require some liquidity provision from the central bank since only the central bank can provide additional liquidity to the system.

<sup>43</sup> The U.S. implementation of the LCR is more stringent than the international standard. It restricts HQLA to a narrower range of assets, sets a more conservative net cash outflow measure, and forces full compliance on an accelerated timeframe, by January 2017.

<sup>44</sup> U.S. firms would be required to be fully compliant with the NSFR by January 1, 2018. The U.S. banking agencies have not yet proposed a separate NSFR rule for foreign banks and their IHCs, but have indicated their desire to do so. Absent a separate rulemaking, the IHCs would become subject to the full or modified NSFR to the extent they have U.S.-based subsidiary depository institutions and they exceed \$50 billion in assets on a consolidated basis. IHCs that meet these criteria would need to comply with the U.S. NSFR on the same timeline as domestic BHCs (as proposed, January 1, 2018). Notwithstanding the application of the U.S. NSFR rule, the consolidated foreign bank would need to comply with its home jurisdiction's version of the NSFR.

<sup>45</sup> The Federal Reserve also launched the Comprehensive Liquidity Assessment and Review (CLAR) for firms in the Large Institution Supervision Coordinating Committee (LISCC) portfolio. Supervisors assess the adequacy of the liquidity positions relative to their unique risks and test the reliability of these firms' approaches to managing liquidity risk.

MMMFs more resilient to stress by reducing liquidity, credit, and interest rate risks of their portfolios. A second set of reforms, issued in 2014, aims to further lower the risk of investor runs by requiring a floating net asset value for institutional prime and tax-exempt MMMFs, and granting non-government MMMF boards of directors the ability to impose redemption fees and suspend redemptions temporarily. In response, some funds have converted from prime funds to government funds, representing a shift in assets under management of roughly \$250 billion, with further migration likely as the October 2016 deadline for implementation approaches.

### *Implications of Elevated Reserve Balances for Money Markets*

The Federal Reserve's liquidity provision and asset purchase programs during and following the financial crisis have left an imprint on money markets. Specifically, amid elevated reserve balances, the volume of federal funds trading in which banks borrow from other banks to meet reserve requirements fell considerably, as shown in Figure 5(a). In part, this reflects that the very high level of reserves has substantially reduced the likelihood that unexpected interbank payments could lead to a significant shortfall in reserve balances for a depository institution. Absent this basic impetus for interbank trading in the funds market, volume in the federal funds market dropped significantly once the level of reserves reached \$750 billion or so. For similar reasons, the intraday and intra-maintenance period patterns in the federal funds rate that were evident before the crisis faded and daylight overdrafts are far less pronounced today.

Instead of bank-to-bank trading, most federal funds activity today reflects lending by FHLBs to DIs, and, consistent with the weighted average rates earned by DIs and GSEs shown in Figure 6, virtually all federal funds trades take place at rates below IOER.<sup>46</sup> GSEs do not earn IOER and thus may lend in overnight markets at rates below IOER for a variety of reasons. FHLBs—currently by far the largest lenders of federal funds—strictly limit the number of counterparties and the amount they will lend to each one, reducing borrowers' incentive to offer higher rates. Moreover, banks' willingness to use capital for IOER arbitrage may have been reduced as a result of the stressed environment when IOER was implemented and, more recently, as discussed below, regulations reportedly may have made these low-margin trades less profitable for many domestic banks. The result is that most federal funds transactions now are “arbitrage trades” in which FHLBs lend at a rate below IOER to FBOs that earn IOER. There remains some trading between banks, albeit at small volumes.<sup>47</sup> A simple theoretical model of a non-competitive federal funds market, illustrated in Figure 7, would suggest this outcome. As shown in the figure, if reserve balances are high, the effective federal funds rate falls

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<sup>46</sup> FR2420 data suggest that year-to-date, only 3 percent of federal funds trades occur above the IOER rate.

<sup>47</sup> There are occasionally federal funds borrowings by smaller banks occurring at rates above the IOER rate. However, there are also trades between banks at rates lower than the IOER rate, likely representing a correspondent-respondent or other relationship lending.

below the IOER rate. The model also predicts that as reserve balances fall, the effective federal funds rate moves above the IOER rate.<sup>48</sup>

More generally, elevated reserve balances may have affected business models for many market participants, particularly for bank portfolios. At the same time, FBOs have reportedly sought reserve balances as a dollar liquidity buffer.

### *The Interaction between Developments in Monetary Policy and Regulation*

In light of the severe financial market disruptions caused by the instability of short-term wholesale funding during the crisis, many regulations were intended to reduce firms' reliance on wholesale funding. Consistent with this intent, money market volumes have fallen across a wide range of instruments. First, as shown in Figure 8, over the 2009-2015 period, dealers that were subject to the Basel III regulations reduced their overnight repo borrowings significantly more than dealers that were not.<sup>49</sup> Moreover, dealers that were subjected to more robust local versions of the regulations (such as dealer subsidiaries of U.S.-based bank holding companies) reduced their repo borrowing to an even greater extent than dealers subject to less robust ones. Second, the SLR has reportedly also led to declines in intermediation by repo dealers. Third, as shown in Figure 5(b), total volumes in unsecured funding markets plunged on quarter-ends, reflecting reduced borrowing by FBOs on their SLR reporting dates.

Regulations have also had effects on the distribution of reserve balances. For example, in part because FBOs are largely exempt from the FDIC fee and thus the expanded FDIC assessment base, a disproportionate share of the higher reserve balances that resulted from asset purchase programs were absorbed by FBOs.<sup>50</sup>

As shown in Figure 2, spreads between Treasury repo rates trading on different platforms have widened since January 2014. Absent frictions, the Treasury GCF and Treasury tri-party repo rates should be identical; the wider spread reportedly reflects institutional frictions, which could include regulatory factors or some tiering of rates for smaller dealers that generally have less access to direct lending from money fund counterparties. Under this scenario, larger dealers borrow from MMMFs in the broader tri-party market, and lend the funds to smaller dealers in the GCF market. Because the initial borrowing expands the larger dealer's balance sheet, the GCF rate can rise notably above the tri-party rate, to compensate dealers for that balance sheet expansion.

The ON RRP facility has also interacted with changes in the regulatory environment. On quarter-end, FBOs often pare the size of their balance sheet by running off overnight federal funds borrowing and Eurodollar deposits, reportedly in an effort to improve their

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<sup>48</sup> Refer to "Theoretical Explorations by the Money Markets Group of Long-run Framework," memo to Research Directors, July 5, 2016.

<sup>49</sup> This finding is robust to controlling for other factors causing a decline in repo borrowing, such as a reduction in demand for borrowing or lower availability of collateral.

<sup>50</sup> Another factor that could have contributed to FBOs holding a large share of reserve balances was the desire for dollar liquidity.

regulatory ratios. At these times, MMMFs place funds that would ordinarily be invested with FBOs in the Federal Reserve's ON RRP program.

In addition, market participants suggest that overall, term money market volumes have dropped below pre-crisis levels. However, market participants report that some regulations, including the LCR, encourage term funding instead of overnight funding for banks. At the same time, other regulations, including money fund reform, promote significant holdings of shorter-term assets. As a result, there has been higher demand for term funding coincident with a decrease in the supply of term funding and a corresponding increase in the supply of overnight funding. Taken together, these demand and supply effects suggest a steepening of the yield curve at short horizons. Market participants have cited this phenomenon as one explanation for the somewhat wider LIBOR-OIS spread seen recently.

Alongside these effects on rates and volumes, regulations may have encouraged the creation of new, safer money market instruments and new entrants into money markets. For example, "evergreen clauses" are now common in financing repo backed by non-traditional collateral. These clauses imply that the trades are "good-until-cancelled," so a dealer can finance non-traditional collateral with tenors that are permanently 91 days until either party gives notice that they want to exit the trade. At that time, the repo trade has an actual 91 day maturity, and so has favorable treatment for regulatory purposes, compared with the pre-crisis practice of funding such collateral with overnight repo.

In addition, there is a small, but growing, trend to have cash investors (e.g. pension funds) trade repo directly with cash borrowers (hedge funds), rather than using a dealer as the intermediary. While these trades have reportedly been in existence for some time, it is likely that notional amounts of direct repo are still quite small. Of note, MMMFs are very risk averse and most MMMFs do not engage in these trades.

Finally, there has been some growth of small non-primary dealers that are able to employ high leverage because they are generally not subject to the same macroprudential regulations as larger dealers. Although investors feel protected in repo transactions because of the haircuts they receive, the substantial leverage relative to capital necessary for these dealers to operate will likely preclude them from getting very large.

#### *Arbitrage Relationships and Money Market Rates*

Although there have been changes in the monetary policy implementation, business models and regulatory frameworks in recent years, money market rates remain correlated, albeit less so than before. Moreover, the Federal Reserve's policy tools continue to be very effective in influencing short-term rates. The FOMC's decision to tighten policy in December of last year provided the first clear indication of how money market interest rates might react to changes in the Federal Reserve's administered rates—the IOER and ON RRP rates—and how the configuration of rates might evolve in moving away from the zero lower bound. Increasing the target range for the federal funds rate and raising

the IOER and ON RRP rates proved effective in raising money market rates in December 2015.<sup>51</sup> Those actions resulted in immediate increases in all overnight rates without sizable changes in volumes and flows in these markets, suggesting no changes in patterns of intermediation as a result of the rate increase.<sup>52</sup> Together, this evidence illustrates that the fundamental driver of rate correlation, market integration and arbitrage by borrowers and lenders, remains intact.

That said, measured on a daily frequency, money market interest rates co-move less than in the past. For example, as shown in Figure 1, a range of money market interest rates moved within a few basis points of each other prior to the crisis, and a common factor explained nearly 95 percent of the variation in these series from 2001 to 2006. More recently, there is greater dispersion across these money market interest rates, as the share of variation explained by a common factor has fallen to about 85 percent from 2010 to 2015. While it is difficult to identify precisely all the factors that have led to this changed behavior, market participants indicate that regulations may inhibit some types of arbitrage activity across markets. In addition, many firms simply became more cautious in managing credit, interest rate, and liquidity risks since the crisis.

## V. Market Participants' Views and Changes in Business Practices

To gain possible insight into the evolution of money markets, staff interviewed many money market participants, who discussed several aspects of overnight and short-term funding market functioning including relevant reference rates for markets, price discovery and the extent to which markets are connected. Respondents also offered insights into how their behavior and business practices have been affected by changes in regulation and the operating framework.<sup>53</sup>

### *Activity in Federal Funds and Repo Markets*

Market participants' views on recent money market activity are generally consistent with the observed outcomes discussed above. Overall, market participants saw money markets as relatively well connected, with some pockets of segmentation. Along these lines, FHLBs reported some degree of money market segmentation since rigidity in dealer repo positions precludes FHLBs from investing funds, at the margin, in GC repo markets, leaving their investments more concentrated in federal funds. And, despite having a significant presence in federal funds, some FHLBs reported feeling like a "price

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<sup>51</sup> It is difficult to assess the relative impact of IOER and the ON RRP on the post-liftoff configuration of money market rates, as well as to isolate the effects of lift-off or the ability of the \$2 trillion ON RRP cap to place a firm floor under rates. That said, Federal Reserve tools for managing short-term interest rates successfully supported the rise in the target range, with limited shifts in the composition of Federal Reserve liabilities.

<sup>52</sup> Refer to Anderson, "Monetary Policy Transmission and the ON RRP," Board memo, April 6, 2016.

<sup>53</sup> Respondents represented securities lending, MMFs, commercial paper dealers, banks, GC repo dealers, and FHLBs. Refer to "Current Conditions in U.S. Money Markets as reported by Market Participants," memo to Research Directors, July 1, 2016.



taker.” In turn, GC repo dealers viewed unsecured and secured markets as somewhat bifurcated. Consistent with sound liquidity risk management given the long-term nature of their assets (as well as liquidity regulations such as the LCR), FBOs expressed a strong desire to borrow at tenors of three months and beyond, although they are very willing—apart from month- and quarter-end dates—to borrow in very short tenors to arbitrage between the federal funds and IOER rates.

As noted above, most of the trading in unsecured money markets represents “IOER arbitrage,” or FBOs borrowing funds from non-banks at a rate below the IOER rate, thereby earning the spread between IOER and the negotiated rate. Respondents suggested that IOER arbitrage demand from FBOs is stable as long as they can earn a spread of at least 5 basis points. FBOs have cited the avoidance of daylight overdrafts as an ancillary benefit of maintaining relatively large reserve balances.

Respondents identified an array of relevant “comparator rates,”-that is, a rate that identifies the general state of markets. Market participants said the IOER rate plays a key role in the federal funds and Eurodollar markets, particularly in setting relevant spreads. For example, one participant commented that the current “equilibrium state” is characterized by having the EFR and the overnight bank funding rate (OFR) lie halfway between the IOER and the ON RRP offered rates and overnight Treasury GC repo rates lie halfway between unsecured rates and the ON RRP offered rate. Some participants stated that the ON RRP offered rate has become a very important comparator rate for domestic money markets.

However, several market participants had other views. Some commercial paper and GC repo dealers saw overnight Treasury repo rates as the best comparator rate. By contrast, views of on-the-run Treasury bill rates as a comparator rate were mixed: some saw Treasury bills as an important reference rate across all money markets, while others viewed bill yields as idiosyncratic. Nevertheless, many market participants saw relatively little need for a “comparator rate” from a price discovery perspective since overnight funding market rates have been remarkably stable for some time.

### *Effects of Regulations*

Many respondents suggested that regulations have had important pricing effects on money markets. A number of investor groups reported buying or selling products that are by themselves “unprofitable”. They claim these products were profitable before the crisis when liquidity and counterparty risks were underpriced. Market participants reported continuing to engage in these transactions because they may be able to enter into other transactions with the same counterparties that are profitable or favorable for regulatory reasons. For example, some FBOs strongly preferred issuing liabilities with tenors greater than three months to satisfy regulatory requirements for sound liquidity risk management, and said they were willing to borrow overnight funds from certain counterparties to potentially obtain longer term funding from the same counterparties. Although MMMF portfolio managers did not acknowledge any implicit “bundling” between their trades in short and long term bank liabilities with individual banks, most

managers acknowledged that issuers of their longer term bank paper tend to be the same entities issuing them products with tenors of seven days or less. Of note, money fund reforms have reportedly increased MMMFs' demand for safe and highly liquid assets, especially at specific maturities, such as overnight and one week.

Other participants reported ceasing one or more activities altogether because of regulations. In particular, leverage ratios have reportedly made it more costly for bank holding company-affiliated dealers to use their balance sheets to engage in repo market arbitrage. Not only are these dealers reluctant to engage in arbitrage, they report limiting overall customer repo activity, including turning some customers away, with a view that traditional repo transactions are now a "loss-leader" owing to recent regulations. Perhaps because of this, several market participants described customer GC repo as an "allocated market" in which price plays only a secondary role as a clearing mechanism.

Capital requirements have reportedly led some dealers to focus on transactions that can be netted, to avoid increasing total assets.<sup>54</sup> Some participants cited netting as a critical determinant of their repo activity. Reportedly, strict controls on daylight overdrafts and unwinding repo transactions (resulting from the recommendations of the Tri-Party Repo Infrastructure Reform Task Force) have reduced the appeal of GCF repo to some dealers.

As noted above, MMMFs are required to keep a large fraction of their assets under management as very short term and liquid.<sup>55</sup> They report that they now have less difficulty in becoming fully invested in these short tenors following the introduction of ON RPP operations, although this difficulty still persists on month-ends and quarter-ends. Some participants believe that the FOMC could encounter some difficulty in completely eliminating the ON RRP facility given its importance to money market functioning. While FHLBs actively invest in repo, fed funds are preferred over tri-party repo investments because maturing proceeds can be returned much earlier in the day.

Finally, some market participants opined that recent changes to the monetary policy implementation framework and regulations could have made some individual markets more "fragile," as a result of changes in business practices. For example, transactions involving FHLBs as sellers in the funds market now comprise 95 percent of all federal funds sales. In addition, the Eurodollar market, while much larger and more robust than the fed funds market, is dominated by FBOs purchasing funds to arbitrage IOER. Moreover, in seeking stability in their repo books, dealers routinely turn away investors, which limits the availability of GC repo as an investment vehicle, at the margin. Further, dealer focus on netting balance sheet items could lead to trading patterns that may distort market functioning by encouraging trades that would otherwise be uneconomical. Finally, dealers will also turn away some repo counterparties that are not engaging in other, more profitable, business with the firm.

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<sup>54</sup> "Netted transactions" are those that, following Generally Accepted Accounting Principles, are reflected in the balance sheet on a net, rather than a gross, basis. Most, but not all, netted repo transactions use the Fixed Income Clearing Corporation (FICC) as a central counterparty.

<sup>55</sup> The MMMF 2a-7 requirements were enhanced; see the "Money Markets: Regulations," memo to Research Directors, for details.

### *Changes in Business Practices*

In addition to the discussion above, there have been other changes in business practices of firms involved in money markets. First, in the wake of the crisis, Fannie Mae and Freddie Mac decided to cease unsecured lending in the federal funds market, and FBOs in particular. Pre-crisis, both Fannie Mae and Freddie Mac were active federal funds market lenders; they even lent funds at a lower-than-average rate in order to ensure the return of these funds early in the trading session. Fannie and Freddie's withdrawal occurred around the time of acute stresses in European peripheral sovereign debt markets, and perhaps reflected a renewed commitment to minimize risk exposures.

Second, firms have made changes on their own to their risk management practices that may affect money markets. For example, markets for short-term funding might be expected to decline in size and individual institutions may find it less attractive to expand their balance sheets without a commensurate increase in capital and liquidity positions. In addition, some dealers reportedly encouraged clients to provide longer-term funding of certain collateral positions in the repo market to allow the dealer to better match the duration of their repo assets and liabilities. While some regulations encourage these measures, firms have reportedly undertaken such measures independent of the regulatory reforms.

And third, some firms have dropped out of money markets altogether. For example, heightened investor credit risk aversion following the financial crisis has generally shut lower-rated unsecured money market issuers out of markets. As a result, only top-rated issuers remain. Because this has decreased the supply of commercial paper and increased the quality, top tier issuers could drastically reduce the rates paid on commercial paper and still attract investors.

## **VI. Some Questions About the Future Evolution of Money Markets and Possible Connections to Monetary Policy Implementation Frameworks**

As discussed above, the nature and structure of money markets have evolved much over recent years and will likely continue to do so in coming years. As this process unfolds, there are issues which may intersect with questions about the long-run policy implementation framework or other matters of interest for policymakers. Below we offer some very tentative observations regarding a few of these potential issues.

### *Reserve Demand and the Long Run Framework*

One important question is whether the recent experience of depository institutions has fundamentally altered the nature of reserve demand. In balance sheet projections regularly provided in the Tealbook, the staff assumes that normalizing the Federal Reserve's balance sheet will proceed until the level of reserve balances falls to about the current level of required reserve balances. However, some banks have indicated that they

may wish to hold much larger levels of reserve balances now than in the past, both for precautionary and regulatory reasons, particularly if excess reserve balances are remunerated at rates close to the level of market interest rates against a backdrop of regulatory reforms. If that is the case, balance sheet normalization could occur much sooner than the staff now assumes. A much higher “structural” demand for reserves could make monetary policy implementation more challenging if that demand were also quite volatile over time. A very large and volatile demand for reserves might make it more difficult to return to systems that require close management of daily levels of reserve balances to achieve a desired level of short-term interest rates. In particular, pre-crisis, staff at the Desk forecasted the demand for reserve balances each day in order to size the temporary open market operation so that the federal funds rate would trade near the target rate. If demand for reserve balances became more difficult to predict, it would be then be more difficult for the Desk to hit the target on a daily basis. In addition, an elevated level of reserve demand would have implications for the size of the balance sheet, and level and interest rate sensitivity of Federal Reserve remittances and would also raise questions about the role of reserve requirements in monetary policy implementation.

Conversations with market participants suggest that the structural demand for reserves may have increased significantly relative to the pre-crisis experience, in light of recent regulatory reforms and changes in business practices at banks. As noted in the Foreign Experience memo, other central banks are also observing heightened demand for reserves post-crisis. If that is the case, we may begin to see upward pressure on the level of short-term interest rates and a resumption in interbank trading in the federal funds market at a much earlier stage of the balance sheet normalization process than currently assumed. Moreover, if arbitrage across unsecured and secured markets remains the same as current patterns, it might be expected that other money market rates would also follow suit.

More generally, various design elements of the long-run monetary policy implementation framework will likely adjust to reflect regulatory reforms and changes in business practices at banks. For example, under some systems, open market operations might need to be larger than pre-crisis, and if dealers desire to intermediate on a smaller scale, there may need to be a larger and more diverse set of counterparties than there was pre-crisis.<sup>56</sup> Moreover, policymakers will need to consider how regulations interact with particular tools. For example, frameworks that rely on tools like voluntary reserve requirements or term deposits would need to consider how the use of such tools would interact with liquidity regulations. These are just a few examples of the ways in which the design of the new policy implementation framework and the tools used to support it will need to adapt to the change in the regulatory framework.

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<sup>56</sup> Policymakers could also consider operating directly in the relevant financial market to improve arbitrage relationships.

### *Money Markets and Periods of Stress*

During the crisis, money markets were at the center of many of the most important problems. Indeed, some of the most destabilizing forces operating during the course of the crisis involved lenders in short-term funding markets pulling away from banks and nonbanks. Such runs are entirely rational behavior on the part of investors that are concerned about the financial condition of the financial institutions. This year, there have been two episodes of stress in financial markets—the concerns about China and its foreign exchange policy that reached a peak in February of this year and, more recently, the immediate aftermath of the Brexit vote. In both of these cases, U.S. money markets continued to operate well with no signs of the type of indiscriminant runs on banks and nonbanks observed during the financial crisis. While it is too early to be certain, these episodes may provide a bit of evidence that money markets are more stable now than in the past. If that is the case, it would underscore the importance of the capital and liquidity regulations to increase the resilience of financial institutions that have been put in place over recent years in creating a more stable environment. Policymakers' views on the fundamental stability of money markets may inform their judgments about a range of issues associated with the long-run framework including the size and composition of the Federal Reserve's balance sheet and the appropriate level of preparedness to provide liquidity on a large scale.

### *Money Markets and Structural Change*

As noted above, the nature of borrowing and lending relationships in money markets has changed substantially over recent years. Recently, there have been signs that some banks may be moving overnight deposits previously booked through their offices in the Caymans back to their home office with a resulting reduction in measured Eurodollar volume. In addition, the federal funds market now largely represents lending by nonbanks to banks. In addition, some lenders, particularly Fannie Mae and Freddie Mac, no longer lend in overnight unsecured funding markets. Should the arbitrage trade that accounts for most federal funds market trading become less attractive or unsecured lending in general become undesirable (as has been the case to some degree overseas), control of the federal funds rate or even a broader unsecured policy rate could be more difficult.

The spread between the Treasury GCF repo rate and the tri-party Treasury rate has widened, and the GCF rate is more volatile than in the past. Large dealer firms have scaled back their activity in repo markets more generally. And there are regulatory incentives and other pressures on borrowers to limit their activity in very short-term funding markets; in particular, while regulations provide some incentives to reduce activity in low margin businesses and/or risky short-term wholesale funding markets, some firms would have altered their risk management practices even without these regulations. Money markets are currently changing and there is uncertainty associated with its future evolution. This uncertainty will have implications for policymakers' choices of the longer run monetary policy implementation framework.

## **Appendix: Historical Evolution of U.S. Monetary Policy Implementation Framework<sup>57</sup>**

The Federal Reserve adapted its policy implementation framework in response to the changing market and regulatory conditions following the 2008 financial crisis. Such changes are not unprecedented. Throughout its history, the Federal Reserve has modified its operating framework a number of times in response to changing policy objectives and market conditions.

At the founding of the Federal Reserve in 1913, instruments traded in U.S. money markets consisted of commercial paper, self-liquidating loans used to finance trade in goods, and call loans secured by stock market collateral. Indeed, the language in the initial Federal Reserve Act established the System to provide an elastic currency in order to rediscount commercial paper with a view to ‘accommodating commerce and business’. And so the interaction between the Federal Reserve’s framework and money markets began.

The original implementation framework was designed to address the frequent panics and depressions resulting from flaws in the pre-1914 banking system. This original framework relied heavily on the discount window to provide liquidity and stabilize existing money markets.

The Federal Reserve was still in its infancy when World War I added a new policy objective and spurred the first evolution of its implementation framework. Financing the Great War required an enormous increase in Treasury issuance, and the Federal Reserve adopted a new policy designed to keep long-term Treasury borrowing rates low. To achieve this new objective, the Federal Reserve used both existing facilities in new ways and adopted new policy instruments. The Federal Reserve dramatically increased open market purchases of Treasury debt and established preferential financing rates for Treasury collateral at the discount window as part of the “borrow and buy” program to encourage private bank purchases of government debt. The Federal Reserve also adopted new instruments, such as repurchase agreements, to expand its set of “borrow and buy” counterparties beyond those with discount window access. Although adapted for a different purpose, the repo tool proved valuable when the Federal Reserve was forced to support the short-term Treasury market after new wartime taxes had the unanticipated consequence of rendering discount window loans unprofitable.

Shortly after World War I the Federal Reserve once again altered its implementation framework in response to changing market conditions. Wartime purchases expanded the Federal Reserve’s balance sheet. Open market operations in the early 1920s resulted in the “discovery” that the U.S. money market had become geographically integrated and monetary policy objectives could be achieved by either adjusting the discount rate or via open market purchases. At this time, there were many discussions about the size of the Federal Reserve’s balance sheet with some advocating a large balance sheet for financial stability reasons. After much debate about the appropriate role of balance sheet versus discount rate tools and the appropriate size of the

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<sup>57</sup> Refer to “The Federal Reserve’s Evolving Monetary Policy Implementation Framework,” memo to Research Directors, July 1, 2016, for more information.

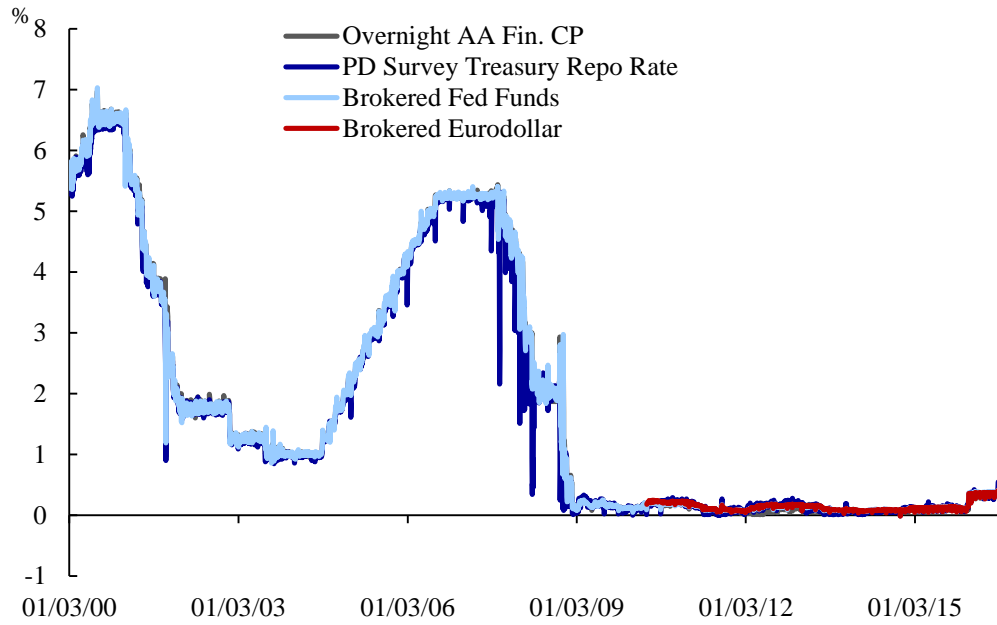
balance sheet, the Federal Reserve adopted what would be known as the 1923 framework which codified the goals of open market purchases and established the Open Market Investment Committee—a forerunner of the FOMC.

The repo tool lay dormant during the Great Depression and World War II but reappeared in the late 1940s when a new monetary implementation framework that targeted free or “un-borrowed excess” reserves was introduced. This new framework required a tool to quickly inject or withdraw large amounts of reserves into the banking system and repo operations were re-introduced to handle the job.

These historical examples suggest lessons relevant to the current development of a long-run framework for implementing monetary policy. Since 1913, the Federal Reserve’s choice of policy implementation tools was affected by evolving market conditions. Related, and with necessity being the mother of invention, a facility adopted for one purpose sometimes ended up being used for quite another. The discount window that was originally intended to help meet seasonal fluctuations in demand for currency without cycles of tightening or loosening money market conditions proved ideal for targeted support of long-term Treasuries. A repo program that was originally designed to support secondary market dealer activity was reconfigured into a facility for reserves management.

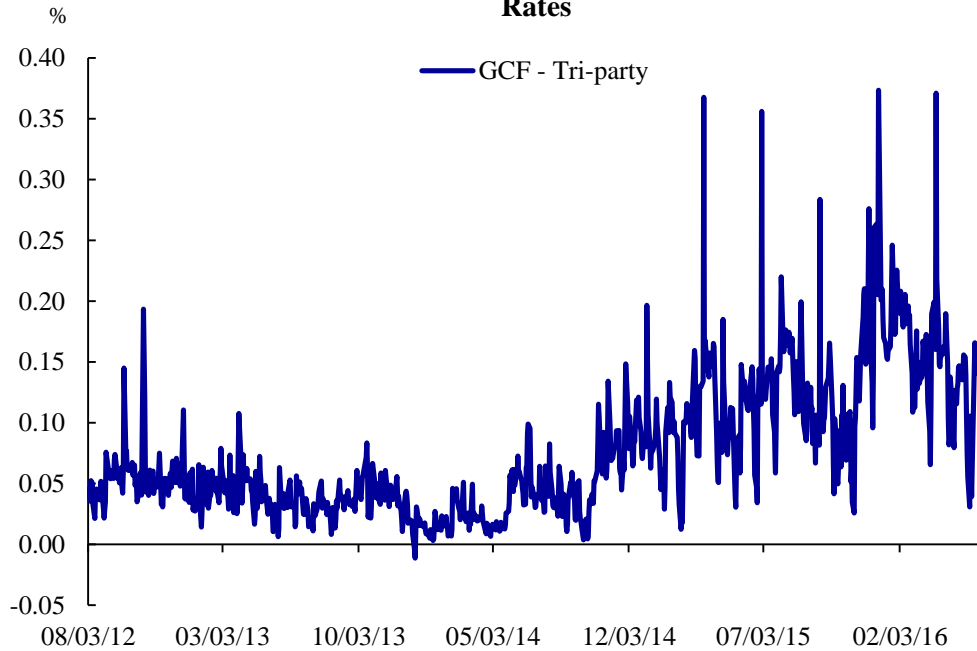
Examining the past can help shape today’s discussions. In the past, as now, Federal Reserve’s implementation framework has responded to events. Important lessons from history are that there can be unforeseen consequences of a framework choice, and that it may take decades before the kinks of a new framework are fully ironed out.

**Figure 1: Overnight Money Market Rates**



Source: FRBNY, Board of Governors, Bloomberg

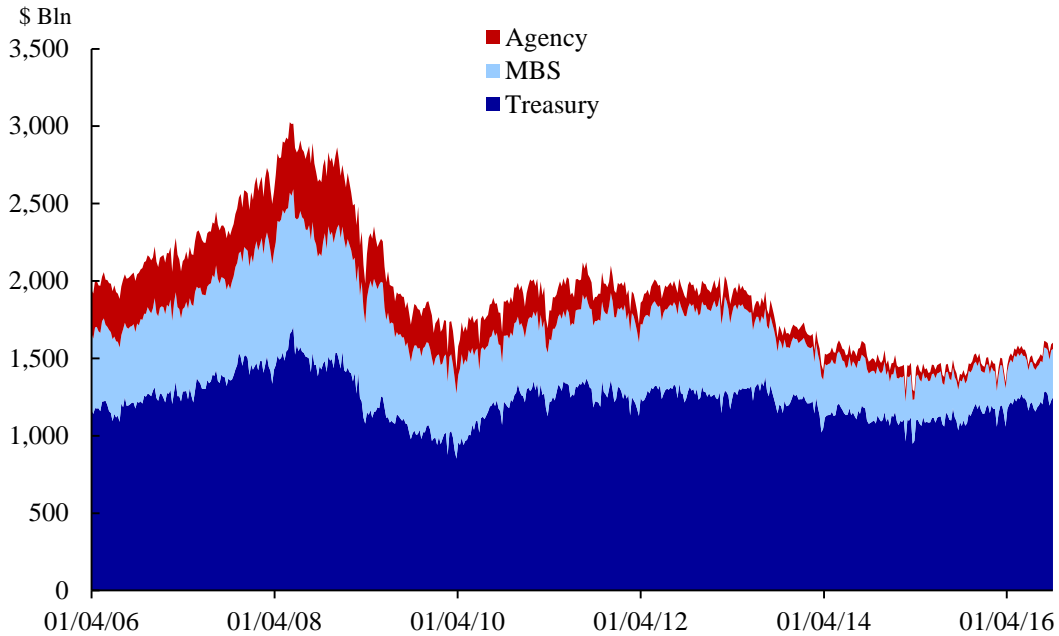
**Figure 2: Spread between Treasury GCF and Tri-party Repo Rates**



Source: BNYM, DTCC

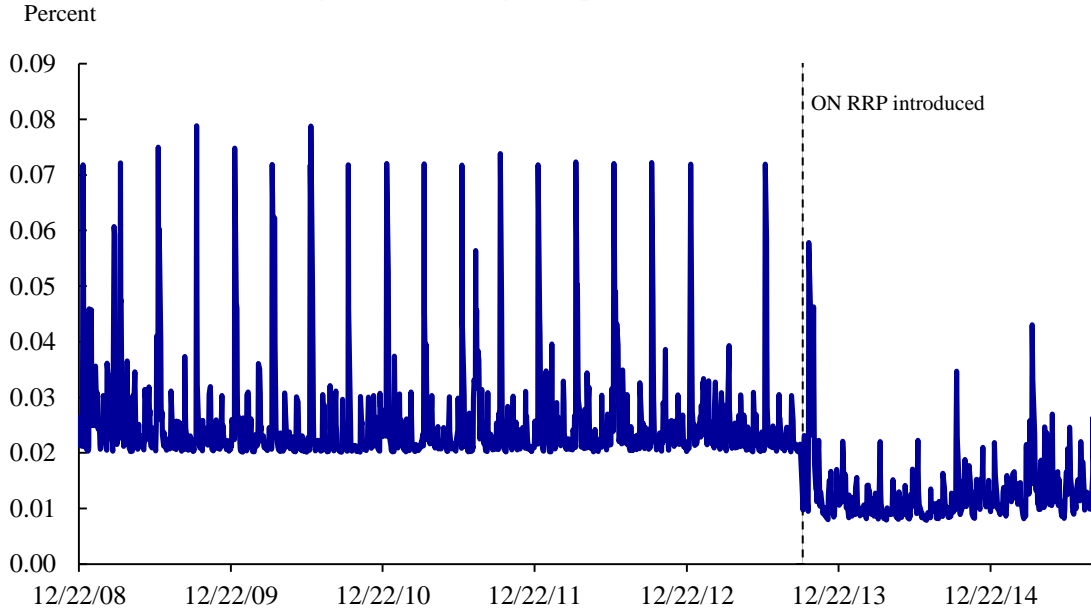


**Figure 3: Primary Dealer Secured Borrowing\***



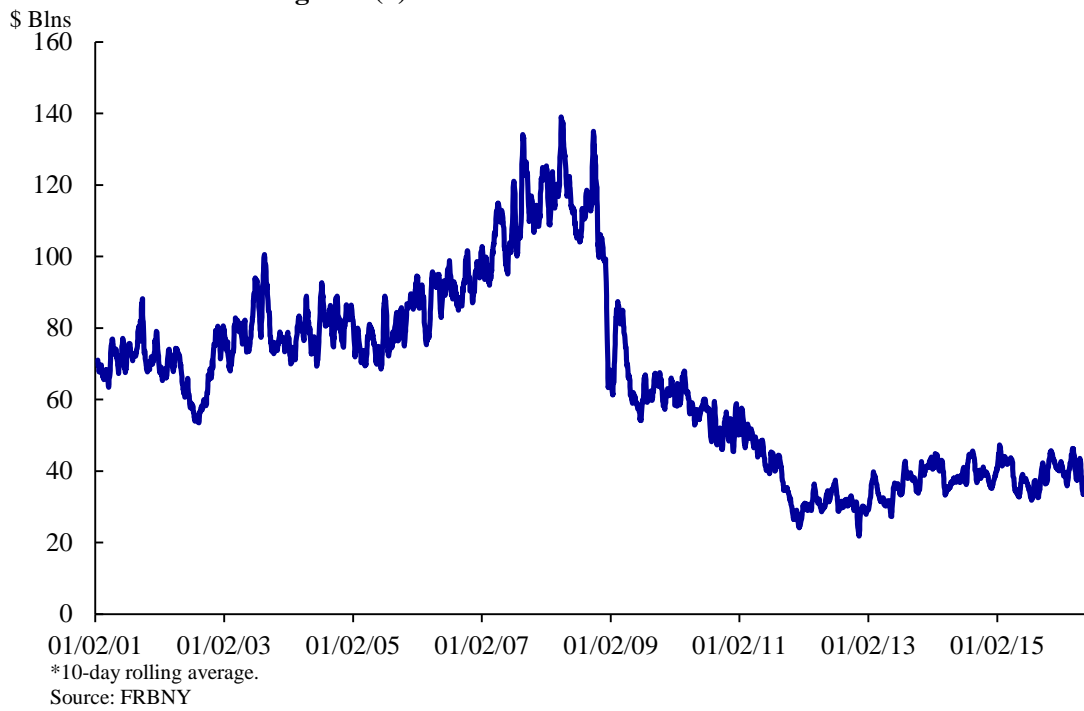
\*Includes repo as well as securities lending and other secured borrowing activity.  
Source: FRBNY, FR2004C

**Figure 4: Overnight Repo Volatility**

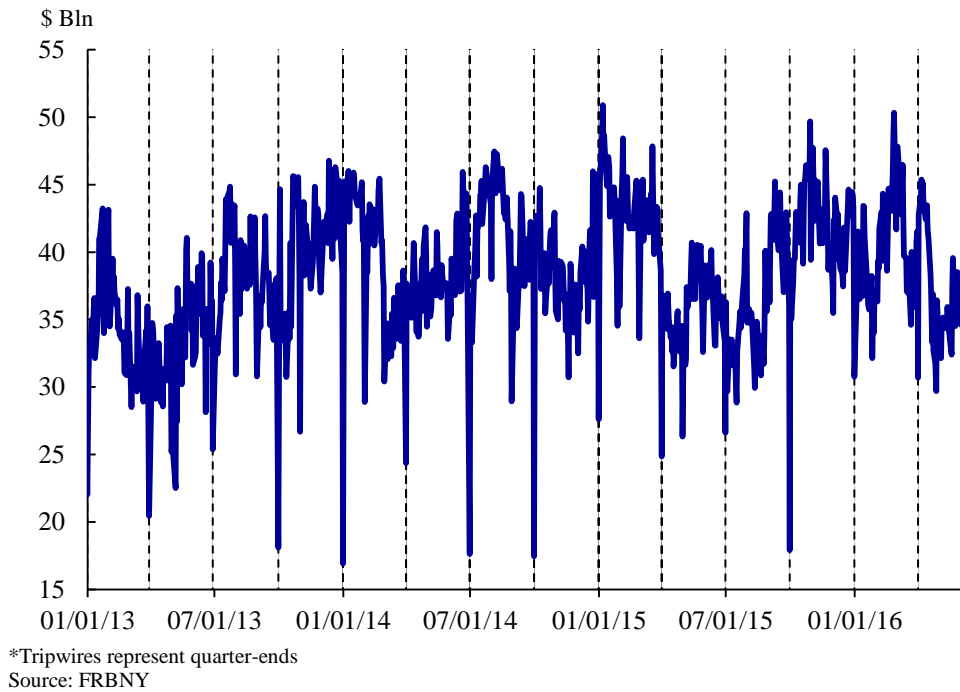


Source: Estimated volatility of the primary dealer survey repo rate (RP) from a GARCH model with month-end and quarter-end effects.

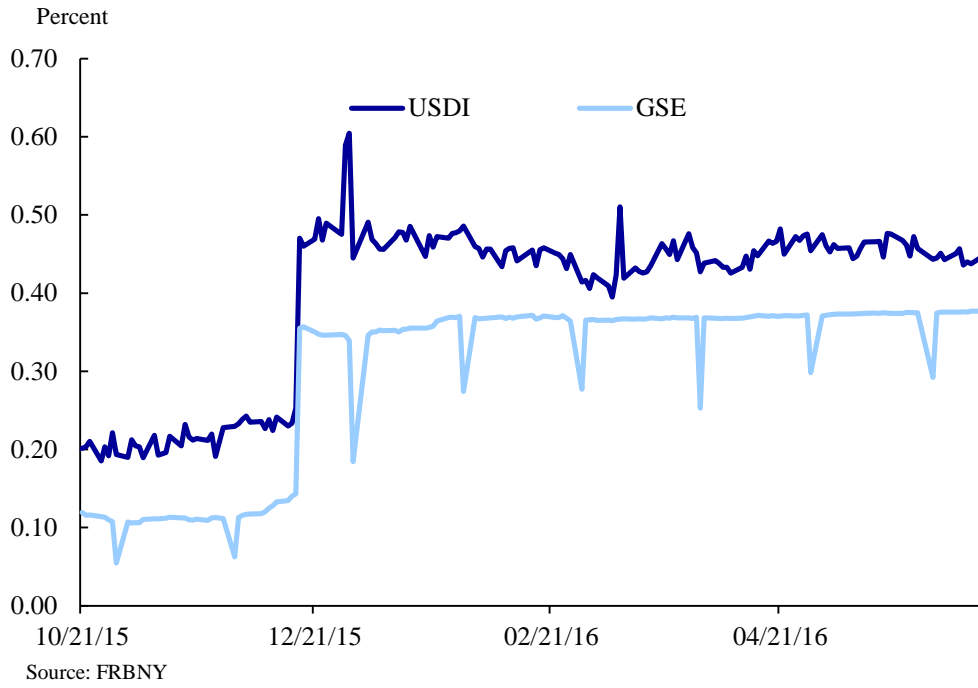
**Figure 5(a): Historical Brokered Fed Funds Volume\***



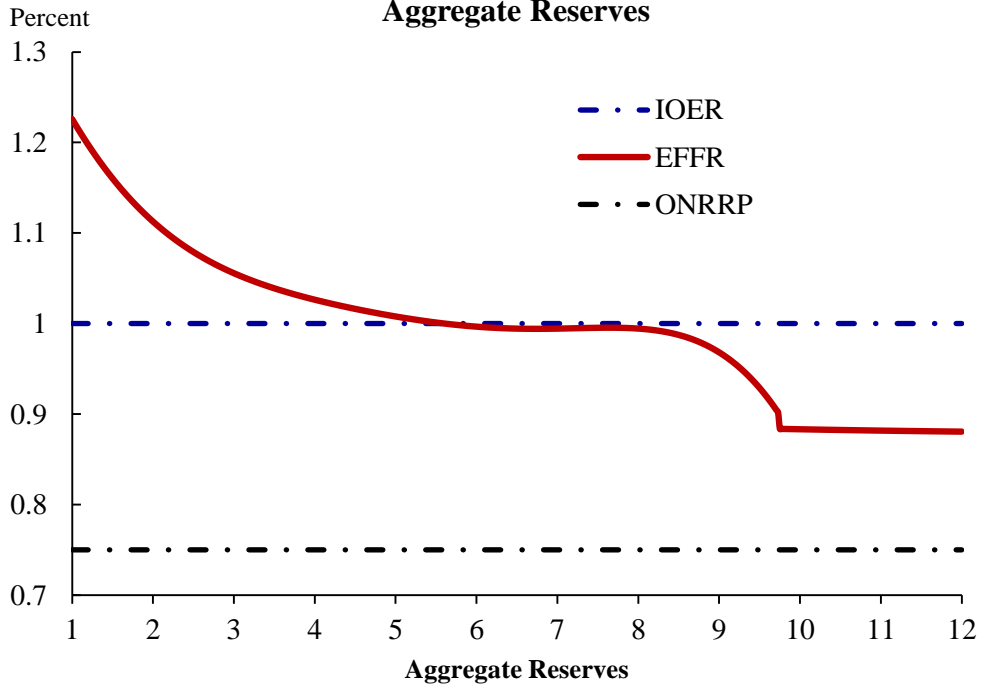
**Figure 5(b): Recent Brokered Fed Funds Volume\***



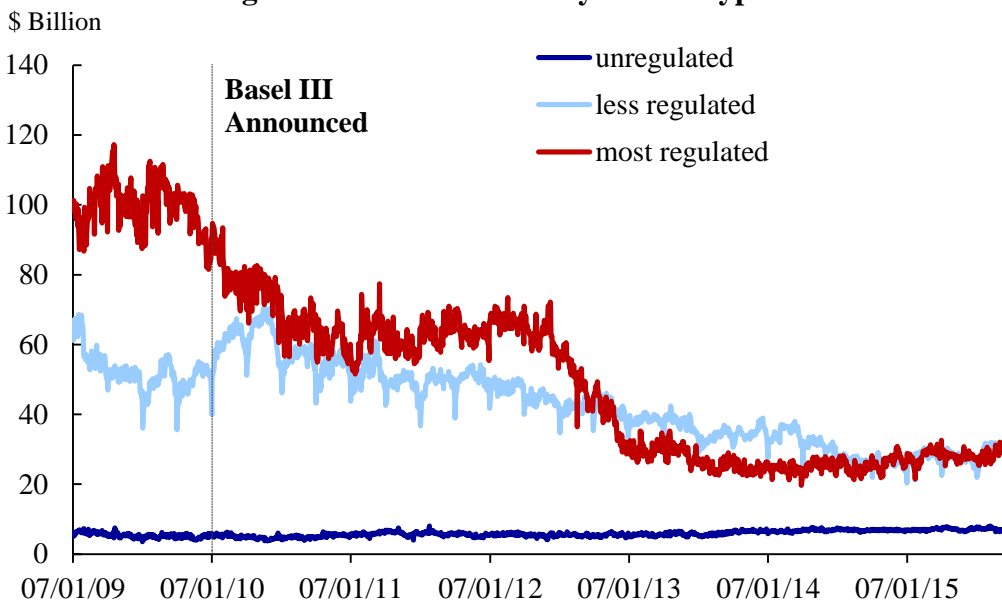
**Figure 6: VWA Fed Funds Rate by Lender**



**Figure 7: Model Predicted EFFR vs Aggregate Reserves**



**Figure 8: Intermediation by Dealer Type**



**Note:** Showing the daily average repo position across all dealers by regulation bucket. Includes Treasury, MBS, and Agency repo positions.  
**Source:** FRBNY, Primary Dealer survey data

**Table 1: US Money Market Financial Assets (\$ Billions)**

	US Depository Institutions	Foreign Depository Institutions*	Money Market Mutual Funds	Broker-Dealers	GSEs
Fed Funds	22	1	-	-	49
Repo	184	205	597	1,115	112
Open market paper **	57	-	333	20	6
Treasury Securities	435	79	546	91	91
Agency and GSE-backed Securities	1,930	23	461	103	283
<b>Memo: Total Financial Assets</b>	<b>14,388</b>	<b>2,041</b>	<b>2,759</b>	<b>3,051</b>	<b>6,458</b>

Source: Board of Governors, Z.1 report.

\*Includes IBFs.

\*\*Includes Commercial paper and Bankers' Acceptances.

**Table 2: US Money Market Financial Liabilities (\$ Billions)**

	US Depository Institutions	Foreign Depository Institutions*	Money Market Mutual Funds	Broker-Dealers	GSEs
Fed Funds	40	30	-	-	-
Repo	154	373	-	1,366	-
Open Market Paper*	-	-	-	-	-
Treasury Securities	-	-	-	-	-
Agency and GSE-backed Securities	-	-	-	-	6,350
<b>Memo: Total Financial Liabilities</b>	<b>14,994</b>	<b>2,111</b>	<b>2,759</b>	<b>3,020</b>	<b>6,455</b>

Source: Board of Governors, Z.1 report.

\*Includes IBFs.

\*\*Includes Commercial paper and Bankers' Acceptances.