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Fed Repo Operations and Dealer Intermediation ^{*}

Mark Carlson, Zack Saravay, and Mary Tian [†]

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Abstract

We examine how primary dealers utilized repo operations conducted by the Federal Reserve from September 2019 until May 2020 and how usage affected dealer borrowing and lending. Using daily dealer-level supervisory data, we find that during normal market conditions, dealers primarily used Fed repo to expand their total repo borrowing and on-lent much of this funding to a broad variety of counterparties. However, during market stress in March 2020, dealers used Fed repo as a substitute for funding from other counterparties and focused their on-lending to affiliated counterparties. Moreover, dealers with more headroom under the Supplementary Leverage Ratio requirement used more of their Fed repo borrowing to provide intermediation in funding markets. Our results underscore the critical role that the Fed’s repo operations played, especially in March 2020, by reducing dealer funding stress and enabling dealers to pass on liquidity.

Keywords: Federal Reserve, dealer intermediation, funding markets, repo operation, Standing Repo Facility, leverage ratio

JEL Classification: E58, G23, G28

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1 Introduction

A disruption to the orderly functioning of repo markets in September 2019 led the Federal Reserve (Fed) to restart its daily liquidity-providing repo operations with its broker-dealer counterparties. The size of those repo operations increased dramatically during the severe stresses of March 2020 as the Fed used this tool, among others, to calm financial markets. As markets settled, and the Fed added substantial amounts of reserves to the system through its asset purchases, uptake at the repo operations dropped to negligible levels.

Repo operations by the Federal Reserve that add reserves to the banking system promote overall liquidity in the financial system and have long been a part of monetary policy implementation.¹ Repo operations may also enhance the balance sheet flexibility of the large broker-dealers that are the Federal Reserve’s counterparties, known as the primary dealers, and contribute to the transmission of monetary policy. A key question, and the focus of this paper, is whether there is empirical evidence of this transmission channel, in normal times and the extent to which this liquidity transmission process continues to work during periods of market turmoil when the major broker dealers come under serious strain.

To answer this question, we use daily dealer-level supervisory data on liquidity profiles to study how primary dealers used the repo operations conducted by the Federal Reserve from September 2019 until May 2020. We examine how things worked in “normal times” and whether they changed during stress periods. Our data contain information on both the types of counterparties for dealer operations and relationships of these counterparties with the dealers and thus provide a detailed picture of the flow of Fed liquidity. We explore whether Fed repo replaced funding from other sources or was used to expand the dealers’ balance sheets. We then consider whether dealers used the funds they obtained from the Fed to expand their lending to other counterparties and, if so, which ones. This piece of the analysis is particularly important for understanding the transmission of Fed liquidity through dealers to the rest of the financial system and how it changed during stress. Our results indicate that, during stress times, dealers focused on providing liquidity to other parts of

¹The Federal Reserve also conducts reverse repo operations with money market funds and other financial institutions that reduce the amount of reserves in the banking system.

the holding companies with which they are affiliated. As those holding companies are vital players in many financial markets, supporting their liquidity is vital for overall financial stability; however, these results also point to some limitations on the extent to which repo operations would provide liquidity to the broader financial system.

The first part of our analysis considers how dealer balance sheets, in particular their repo borrowing and lending, is related to their use of Fed repo. To do this, we utilize daily confidential regulatory data on balance sheets collected in the FR 2052a *Complex Institution Liquidity Monitoring Report* from the ten largest dealers and link it to daily dealer-level data on Fed repo operations collected by the Federal Reserve Bank of New York. The FR 2052a data contains granular data on dealers' repo borrowing and lending, decomposed by counterparty type as well as affiliation status. Starting with the liability side of the balance sheet, we examine how liquidity from Fed repo operations was used by dealers, that is, the extent to which it was used to expand their total repo book or to substitute away from repo borrowing from other entities. We find that during normal market conditions, dealers primarily used Federal Reserve repo to augment their total repo borrowing, with each dollar of Federal Reserve liquidity increasing total repo borrowing by an average of \$0.76. However, during stress periods, Fed repo was used to a greater extent as a substitute for funding from other sources, especially repo borrowing from other dealers.

We conduct a similar analysis of dealers' repo lending to examine how much of the liquidity from Fed repo operations was transmitted to the rest of the financial system. During normal times, total dealer repo lending increased, on average, about \$0.53 for each dollar borrowed from the Federal Reserve. The additional repo lending provided by dealers was spread out across a variety of client types, with about half of the increase going to their bank counterparties. During stress events, we find that liquidity was still transmitted from the Federal Reserve through the dealers to markets, though not to the same dollar-for-dollar extent as during normal times. However, the amounts that dealers were borrowing from the Federal Reserve during stress times were also larger, so the amount of credit on-lent by the dealers was not necessarily less.

There are a few possible reasons why dealers might have made more use of Federal Reserve operations. Dealers might have sought more Fed liquidity if it was attractively priced relative to

the market or, alternatively, if they were concerned about the stability of their own funding. These alternative stories would lead to different interpretations of the results. To distinguish between them, we look at dealer bidding behavior at the auctions through which the Federal Reserve was conducting its repo operations. We find that greater use of Fed liquidity is associated with being more likely to bid above the minimum bid rate. Placing higher bids to obtain funding is more consistent with greater use of Fed liquidity being associated with dealer concerns about their own funding and less consistent with the idea that the dealers were taking advantage of attractive pricing.

Some discussions of dealer intermediation in the Treasury market have concerned whether dealers' regulatory constraints, such as the Supplementary Leverage Ratio (SLR) requirement, might have reduced dealers' incentives to provide intermediation. We consider whether dealers with more headroom above the minimum SLR requirement used the Fed's repo operations to increase the size of their repo book by a larger amount as well as on-lent more of the funding to their counterparties. We find evidence that this was the case. In particular, every 1 percentage point increase in a dealer's headroom above the minimum SLR requirement is associated with an increase of repo lending to counterparties by an additional 12 cents per dollar of Fed repo usage.

With detailed balance sheet data on dealers' counterparty types and affiliation status, we are able to explore the extent to which certain dealer relationships with their counterparties mattered. The primary dealers included in our analysis are subsidiaries of large bank holding companies; the dealers play a key role in intermediating liquidity with a range of customers of the holding companies as well as affiliated entities within the holding companies. For instance, dealers borrow from both affiliated subsidiaries of the holding companies as well as from non-affiliates. The dealers also lend to affiliated institutions and non-affiliated firms. In our analysis, we find that dealer relationships with affiliated entities tend to be more stable during stress events than those with non-affiliates. On the liability side, dealers' repo borrowing from affiliated counterparties were little changed during the high stress period in March 2020, while their repo borrowing from unaffiliated counterparties decreased significantly, suggesting that dealers who typically used external funding did so less in March 2020 as the Fed expanded its repo operations.

The findings on the lending side are even more notable, where during the high stress period,

we document that dealers shift their focus towards internal capital markets. In particular, dealers' on-lending of funds received from Fed repo operations to their affiliated counterparties actually *increased* in March 2020, by an additional \$0.22 per dollar borrowed from the Fed, while the extent of on-lending to unaffiliated counterparties decreased by \$0.37 per dollar. The data allows us to see which counterparty types were most affected. While dealers were still on-lending funds received from Fed repo operations during stress times, nearly all of the on-lending went to their affiliate banks and there was a modest pull-back from non-affiliate dealer counterparties.

Overall, our results support the idea that liquidity provided by the Federal Reserve through its repo operations is transmitted to the financial system even during stress, though the nature of that transmission changes. Risk averse dealers should prudently be cautious during periods of heightened stress and uncertainty. So the fact that we find evidence that Fed liquidity is still passed on during stress, albeit to a different degree and to different counterparties, is reassuring. Our results suggest that dealer onlending of Fed liquidity is most stable for affiliated entities. Given the importance of the large bank holding companies that the primary dealers are part of, this liquidity support is vital for financial stability. However dealers do appear to pull back somewhat during stress from their typical lending to unaffiliated dealers, suggesting some challenges the Federal Reserve may face in using repo operations to support liquidity transmission to all parts of the financial system.

Related Literature

Dealers play a pivotal role in providing market liquidity. The funding conditions that dealers face can affect the liquidity of the assets they trade (Brunnermeier and Pedersen, 2009; Macchiavelli and Zhou, 2021). In particular, dealers finance a significant portion of their inventories in repo markets. Strains in repo markets can then negatively affect dealer intermediation activity. Previous work has found evidence of this during the 2008 financial crisis (Copeland, Martin, and Walker, 2014; Gorton and Metrick, 2012; Gorton, Metrick, and Ross, 2020; Krishnamurthy, Nagel, and Orlov, 2014) and in September 2019 (Afonso, Cipriani, Copeland, Kovner, Spada, and Martin, 2020; Anbil, Anderson, and Senyuz, 2021; Copeland, Duffie, and Yang, 2025).

To support market functioning and the liquidity of the primary dealers, the Federal Reserve

established a number of emergency liquidity facilities during the 2008 financial crisis (Fleming, Hrungr, and Keane, 2009; Adrian, Burke, and McAndrews, 2009; Fleming, 2012) and the Covid-19 crisis (Clarida, Duygan-Bump, and Scotti, 2021). Previous studies have examined the effects of these facilities in supporting repo markets (Fleming, Hrungr, and Keane, 2010; Gorton, Laarits, and Metrick, 2020) and the characteristics of dealers who participated in such facilities (Acharya, Fleming, Hrungr, and Sarkar, 2017). Carlson and Macchiavelli (2020) investigate whether lending facilities established by the Fed during the 2008 financial crisis were effective and how they affected the behavior of dealers.

As far as we know, we are the first paper to examine the effect of recent ordinary (non-emergency) Fed repo operations and the transmission of liquidity through dealers to financial markets. While these repo operations were conducted using ordinary authority, the ones conducted during March 2020 were quite large; analyzing them provides insights into the ability of the Federal Reserve to use its regular authority to respond to instances of severe stress. Our results indicate the operations were effective and point to the benefits of these repo operations. These findings support policy proposals made during the Covid-19 crisis that called for an establishment of a permanent repo facility to support market liquidity during stress periods through dealers (Liang and Parkinson, 2020; Group of Thirty Working Group on Treasury Market Liquidity, 2021) and the eventual establishment of a standing repo facility (SRF) by the Federal Reserve in 2021.

This paper also contributes to the broad literature on internal versus external capital markets for financial institutions. While much of the literature focuses on banks, previous work has also found that internal sources of liquidity matter for nonbanks. Cetorelli and Prazad (2024) show that intracompany funding arrangements between affiliated banks and nonbanks are an important driver of the coexistence of commercial banks and nonbank subsidiaries within bank holding companies. Caglio, Copeland, and Martin (2021) find that broker-dealers that were affiliated with banks holding companies during the financial crisis appear to have benefited from the liquidity available from other entities in the holding company. Correa, Du, and Liao (2020) find that intra-firm transfers between depository institutions and broker-dealer subsidiaries are important to dollar liquidity provision. Our paper expands this literature by considering not only how dealers receive support but how they

might extend support, based on whether the support is from internal or external sources of funding.

Our work extends the literature on the effects of regulation, such as the SLR requirement, on dealer intermediation activity (e.g., Duffie, 2020; Afonso, Cipriani, and Spada, 2022; Cochran, Infante, Petrusek, Saravay, and Tian, 2023; He, Nagel, and Song, 2022). Duffie and Krishnamurthy (2016) show that the pass-through effectiveness of the Fed’s monetary policy through money market rates is dampened by the SLR rule, which distorts repo intermediation incentives for bank-affiliated dealers. In contrast to the existing literature, we examine the effects of the SLR in a new dimension, focusing on whether SLR requirements affected dealers’ pass-through of borrowing received from the Fed.

This paper is organized as follows. Section 2 describes the data and methodology. Section 3 examines the relationship between dealers’ usage of the Fed’s repo operations and their intermediation activity on both sides of their balance sheet. Section 4 investigates dealers’ bidding behavior in Fed repo auctions. Sections 5 and Section 6, respectively, explore how dealers’ usage of Fed repo was affected by the Supplementary Leverage Ratio and by whether the counterparties are part of the same holding company. Section 7 concludes.

2 Background and Data

In this section, we provide background on the primary dealers, Fed repo operations, and the data used in this analysis.

2.1 Intermediation activity of the Primary Dealers

Brokers-dealers are key intermediaries in a variety of money and capital markets. They are often involved in underwriting securities and bringing them to market as well as in promoting the liquidity of secondary markets in those securities. As part of making secondary markets, dealers maintain inventories of securities that they finance by borrowing, often through repo contracts in which those inventories of securities serve as collateral for the repos. In addition, dealers provide financing

through repo contracts to clients to enable those clients to trade securities; dealers also borrow through repo contracts to obtain the funding they need to provide financing to their clients.²

The focus in this paper is a set of broker-dealers referred to as primary dealers. The primary dealers are the trading counterparties of the Federal Reserve Bank of New York (FRBNY) when it conducts open market operations in U.S. Treasury securities and agency securities to implement monetary policy.³ Correspondingly, the primary dealers are particularly important intermediaries in the markets for those securities. These dealers are expected to bid meaningfully in Treasury auctions, consistently placing bids for their own book or on behalf of their clients. The primary dealers also play a substantial role in the secondary market for Treasury and agency securities. Part of that activity involves trading and making markets in those securities. Another part of supporting the secondary market in these securities involves lending against them in repo markets—such as to hedge funds, other dealers, and other clients—and borrowing against them—such as from money funds, insurance companies, other investment vehicles.

While fairly modest in number, the primary dealers are a diverse set of financial institutions. A few are modestly-sized, stand-alone entities. Others are parts of large financial holding companies, some of which are headquartered in the United States and others of which are headquartered abroad (such as in the United Kingdom, Canada, or Japan). In cases where the primary dealer is a part of a financial holding company, that company typically offers a wide range of financial services and will have numerous other subsidiaries which may include other broker-dealers (some in the United States and others abroad, especially in London), a banking operation, mutual funds, and other entities. Primary dealers interact and provide a variety of financial services to these affiliated companies. The analysis in Section 6 explores whether these affiliations matter as dealers make adjustments to their activities at times when the dealers are utilizing the Federal Reserve’s repo facilities.

²Dealers engage in a host of other activities as well, such as securities lending, offering derivative contracts to allow clients to hedge positions or take leveraged positions, providing investment advice, and other services. We focus on repo borrowing and lending because it is key to the analysis below.

³A list of these institutions may be found on the website of the Federal Reserve Bank of New York (FRBNY): <https://www.newyorkfed.org/markets/primarydealers>.

2.2 The Federal Reserve repo operations

While repo lending operations by the Federal Reserve to add reserves to the banking system have long been used as a part of monetary policy implementation, prior to the financial crisis of 2008, these repo operations were fairly modest in scale, averaging on the order of \$20 billion. As a result of the large-scale asset purchases conducted in the wake of the global financial crisis to provide additional monetary policy stimulus and support a return to full employment and stable prices, excess reserves in the system reached about \$2.75 trillion, so reserve-adding repo operations were not needed. In 2015, the Federal Reserve began to tighten monetary policy and excess reserves fell to around \$1.25 trillion by 2019.

This level of reserves in 2019 was substantially above the level that had prevailed prior to the onset of the global financial crisis. Despite this amount of reserves, there was a notable disruption to the smooth functioning of money markets, especially the repo market, in September 2019. Subsequently, Federal Reserve policymakers decided to restart repo lending operations to ensure that the supply of reserves remained ample and to mitigate the risk that pressures in money markets might adversely affect the implementation of monetary policy. The initial operations were for \$75 billion and were subject to a minimum bid rate in the middle of the range that the FOMC had set for its target for the federal funds rate.⁴

Federal Reserve policymakers had already been in the process of easing monetary policy, having reduced their target for the federal funds rate in July 2019. The target for the federal funds rate was further reduced in September and reduced again in October 2019. The minimum bid rates at the auction were reduced alongside the changes to the policy rates.

To further enhance the ability of the repo operations to support market functioning, the Federal Reserve took other actions to augment this facility. Term repo operations, that allowed dealers to borrow for as long as 14 days were introduced in late September. Auction sizes were increased over time so that they amounted to \$120 billion by December 2019 (and \$150 billion over year end).

⁴The constellation of rates at that point was: the target for the federal funds rate was 2 to 2 1/4 percent, the minimum bid rate at the repo auction was set at 2.10 percent; that minimum bid rate was equal to the interest rate that the Federal Reserve paid on excess reserves and was slightly above the interest rate of 2 percent on reverse repo operations conducted by Federal Reserve.

In addition, Federal Reserve policymakers decided to maintain the level of reserves in the banking system at levels about equal to the level that had prevailed in September 2019 by purchasing Treasury bills. These actions appeared to contribute to calmer conditions in money markets.

Financial market turbulence returned with the onset of the Covid-19 pandemic and efforts to contain the virus. To bolster market functioning, auction sizes were increased to \$500 billion in March 2020 and the target for the federal funds rate was lowered nearly to zero. The minimum bid rate at the auction was dropped to 10 basis points.

2.3 Data

Our sample period is from September 18, 2019, when the Federal Reserve restarted repo lending operations, to May 28, 2020, when dealers' usage of the operations dropped to minimal levels. While dealers had outstanding repo contracts with the Fed until July 2, 2020, their active usage of the operations was limited throughout June, especially after FRBNY announced an increase in the minimum bid rate on June 11, 2020.⁵

Our analysis uses the daily, dealer-level data on Fed repo operations collected by FRBNY. The total amount of outstanding overnight and term repo is shown in Figure 1. The total outstanding repo volume averaged just under \$200 billion from September 2019 to February 2020, before surging to almost \$500 billion in March 2020 amid the market turbulence caused by the COVID outbreak. Usage fell back to roughly its previous level in April 2020, and stayed there until it tapered off at the end of June.

Although the total volume of Fed repo increased during the period of high stress in March 2020, the dealers who used the operations most heavily remained largely consistent. Table 1 shows the average daily volume of Fed repo for each of the 10 GSIB dealers in our sample during the pre-COVID, post-COVID, and high stress periods. In general, the heaviest users of the repo operations tended to be the dealers with the largest market share in the Treasury market.

⁵On June 11, 2020, FRBNY announced that the minimum bid rate on overnight and one-month term repo will be set at IOER plus an additional spread of five and ten basis points, respectively.

Importantly, we use confidential regulatory data on dealer balance sheets to examine how dealers’ usage of Fed repo operations affected their other repo borrowing and lending activities. We merge data on usage of Fed repo operations with daily dealer-level supervisory data from the FR 2052a *Complex Institution Liquidity Monitoring Report*. The FR 2052a report collects granular data about institutions’ liquidity profiles, including their repo borrowing and lending, decomposed by counterparty type as well as affiliation status with the dealer.

Our analysis focuses on the 10 globally systemically important banks (GSIBs) that are required to report FR 2052a data on a daily basis. These institutions provide data for the parent company as well as any subsidiaries with a material presence in the U.S. Given our interest in understanding how the Fed’s repo operations were used and transmitted through the financial system, our analysis focuses on the primary dealer subsidiaries. These primary dealers are among the largest broker-dealers and account of around two-thirds of the volume of repo trades across all primary dealers.⁶

The FR2052a provides data on dealers’ repo borrowing and lending and indicates the type of counterparty that these transactions are with. Figure 3 shows the evolution of repo borrowing and repo lending for all the dealers in our sample for the three most important counterparty types (as measured by repo volumes): dealers, asset managers, and banks.⁷ As of June 2020, these three counterparty types accounted for over 90 percent of GSIB dealers’ total repo borrowing and lending. Throughout the sample, dealers borrowed the most from other dealers, while also borrowing significant amounts from asset managers and banks (panel a). Similarly, the majority of dealers’ lending operations are also to other dealers (panel b). In addition, the FR2052a data indicate whether each transaction was conducted with an affiliated or unaffiliated counterparty. As such, we are able create dealer-level variables for repo borrowing and lending with each counterparty type as well as separately for affiliated and unaffiliated counterparties.

In Section 4, we examine the behavior of dealers who bid prices above the minimum specified in Fed repo auctions. We construct a variable *bidRateSpread*, which is the difference between the

⁶Based on data reported on the FR2004.

⁷The counterparty types used in this analysis are representative of broader categories in the FR 2052a report. Dealers represent the “supervised non-bank financial institution” category, asset managers represent the “other financial entity” category, and “banks” are their own category. For more details, see the FR2052a reporting instructions.

rate a dealer bids at the Fed repo auction on a given day, and the minimum rate specified for that auction.⁸

Throughout the paper, we use average CDS levels to identify periods of high market stress in our analysis. The average CDS spread serves as a proxy for the level of concern that investors may have about dealer conditions, and consequently, it is related to dealers’ access to funding markets. We calculate the mean CDS spread, *avgCds*, across the ten dealers in our sample using Markit CDS pricing data, which is shown in Figure 2.

In Section 5, we examine the effect of dealers’ regulatory constraints on their repo borrowing and lending. Each dealer’s regulatory constraint, *slrDistToMin*, is measured as the difference between the dealer’s SLR, which is calculated from the FR Y-9 data and banks’ Call Reports, and the minimum SLR requirement as specified in the Basel III accord.⁹

Summary statistics for the variables described above are shown in Table 2.

3 Effects of dealer Fed repo usage on balance sheets

We analyze how dealers’ use of the Fed’s repo operations was related to their borrowing and lending in the broader repo market and whether there are differences between relatively calm times and the high stress period that started in March 2020 amid the outbreak of covid. When considering dealer repo borrowing, we examine whether dealers used the Fed’s repo operations to expand the size of their repo book, to replace borrowing from other sources, or both. For lending, we examine whether dealers’ use of funding obtained from the Fed’s repo operations is associated with an increase in their repo lending to their counterparties.

⁸On many days, there were separate auctions for Fed repo with different terms and collateral types, which have different minimum rates. Because we run our tests in a daily-dealer panel, we consider the rates across all of the bids for each dealer on a given day and compare them to the minimum bid rates in those particular auctions to determine whether the dealer bid above the minimum rate in any of those auctions. We do this by comparing the average of each dealer’s bids on a given day to the average minimum bid rate on the auctions for which the dealer submitted a bid.

⁹The FR Y-9 provides balance sheet information about the bank holding company and the call reports provide balance sheet information about the commercial bank subsidiaries of the holding companies.

3.1 Methodological details

To estimate the association between dealers' usage of Fed repo and their borrowing and lending in the broader repo market, we use an approach similar to Carlson and Macchiavelli (2020).

On the borrowing side, we explore how changes in the dollar amount of Fed repo used corresponded to changes in the dollar amount of total repo borrowing and in the dollar amount of repo borrowing from particular types of counterparties. This analysis is an informative accounting exercise as there is an adding up constraint where total repo borrowing must equal the sum of its parts.

We use two approaches for considering whether behavior differed when the level of stress was elevated, using the average CDS spread across dealers as a proxy. The first approach takes *highStressCdsDummy_t* as a proxy of high funding market stress, equal to 1 when *avgCds_t* is above the 90th percentile, relative to its historical distribution over our sample period from September 18, 2019 to May 28, 2020. Based on this definition and shaded in Figure 2, *highStressCdsDummy_t* is equal to 1 between March 12 and April 8, 2020. The second approach is to use the average CDS measure as a continuous measure of stress.¹⁰ Consequently, we estimate two separate equations:

$$\begin{aligned} \Delta Repo_{i,t} = & \beta_1 \Delta fedRepo_{i,t} + \beta_2 highStressCdsDummy_t + \\ & \beta_3 \Delta fedRepo_{i,t} \times highStressCdsDummy_t + c + \mu_i + \epsilon_{i,t}, \end{aligned} \quad (1)$$

$$\Delta Repo_{i,t} = \beta_4 \Delta fedRepo_{i,t} + \beta_5 avgCds_t + \beta_6 \Delta fedRepo_{i,t} \times avgCds_t + c + \mu_i + \epsilon_{i,t}, \quad (2)$$

where $\Delta Repo_{i,t}$ is the daily change in the dollar amount of dealer *i*'s repo borrowing from all counterparties (including that with central banks) or by counterparty type. For brevity we only report results for the three largest counterparty types – dealers, asset managers, and banks. These counterparty types account for the bulk of dealer repo borrowing (and lending) with non central bank counterparties. $\Delta fedRepo_{i,t}$, our main explanatory variable, is the daily change in the dollar amount of dealer *i*'s borrowing from the Fed's repo operations. The regressions also include the

¹⁰The first approach, using a discontinuous variable, may be preferred if there are non-linearities associated with high levels of stress. The second approach is more appropriate if behavior is generally linear.

indicators for stress and the interactions of the stress measures with Fed repo usage, in order to examine how dealers' shift from private funding markets to the Fed is affected when market conditions are stressed. Finally, μ_i is a set of dealer fixed effects.

We estimate similar equations on the lending side:

$$\Delta ReverseRepo_{i,t} = \beta_1 \Delta fedRepo_{i,t} + \beta_2 highStressCdsDummy_t + \beta_3 \Delta fedRepo_{i,t} \times highStressCdsDummy_t + c + \mu_i + \epsilon_{i,t}, \quad (3)$$

$$\Delta ReverseRepo_{i,t} = \beta_4 \Delta fedRepo_{i,t} + \beta_5 avgCds_t + \beta_6 \Delta fedRepo_{i,t} \times avgCds_t + c + \mu_i + \epsilon_{i,t}, \quad (4)$$

where $\Delta ReverseRepo_{i,t}$ is the daily change in the dollar amount of dealer i 's repo lending to all counterparties or to specific counterparty types (dealers, asset managers, and banks). This structure is again similar to an accounting exercise, however here there is no adding up constraint.¹¹

3.2 Effects on dealer repo borrowing

We first examine how dealers' usage of the Fed's repo operations was related to their total borrowing in the repo market, as well as borrowing from major counterparty types, by estimating equations (1) and (2). The resulting regression coefficients essentially represent a decomposition of how, on average, each dollar increase in borrowing from the Fed is allocated towards the different components of dealer repo borrowing. Standard errors are adjusted for heteroskedasticity.

The results, shown in Table 3, indicate that outside of the high stress period, dealers used the Fed's repo operations primarily to increase their total repo borrowing and only to a lesser extent to shift borrowing away from other funding sources. In particular, as shown in row 1, for each \$1 increase in borrowing from the Fed's repo operations, \$0.76 was used to increase dealers' repo book size (column 1), while the remainder was used to shift borrowing away from other sources, most notably other dealers (column 3). To gauge the economic magnitude, daily increases in Fed repo usage were more than \$100 million one fourth of the time (Table 2), which based on our estimates,

¹¹Dealers could be funding their repo lending in some way other than repo borrowing; that could result in some disparate movements between the two sides of the balance sheet.

translated to at least a \$76 million daily increase in total repo borrowing per dealer.

During the high stress period between March 12 and April 8, 2020, we find that borrowing from the Fed’s repo operations continued to be associated with an increase in their total repo borrowing, though to a smaller extent (row 3). However, one notable difference is that borrowing from the Fed was associated with a larger decline in borrowing from others during the high stress period, especially dealers’ borrowing from other dealers. A \$1 increase in borrowing from the Fed during this period was associated with an additional decrease in such borrowing of \$0.36 (column 3).¹² Nonetheless, even during the high stress period, not all repo borrowing from the Fed was associated with a substitution away from other counterparties, even if substitution was occurring to a greater extent than at other times.

In addition to our first regression specification in equation (1) where the high stress period dummy depended on a threshold level of average CDS, our second regression specification in equation (2) looks more broadly at the effect of average CDS levels and its interaction with changes in Fed repo usage on dealer repo borrowing. The results are also shown in Table 3. We find that higher levels of average CDS dampened dealers’ total repo borrowing. The interaction of the CDS spread with Fed repo indicates that the boost to overall repo borrowing was less when stress was higher. Moreover, it was particularly during periods of stress when use of Fed repo substituted for borrowing from other dealers. For every \$1 increase in Fed repo usage and 1 percent increase in avg CDS levels, the increase in dealers’ total repo borrowing dropped by \$0.38 (column 2), and the drop was almost entirely with other dealers (column 4).

Therefore, when average CDS levels were around their mean of 0.7 percent at the beginning of March 2020, each dollar increase in Fed repo usage was associated with an increase of \$0.72 in dealers’ total repo borrowing. When CDS levels were at their maximum level of 1.66 percent in late March 2020, each dollar increase in Fed repo was associated with an increase of \$0.36 in repo borrowing. The total amount of borrowing was surging during this period, with average dealer Fed repo usage doubling from \$9.0 billion to \$18.1 billion daily. Thus, our estimates suggest that,

¹²We also looked to see if use of the PDCF was associated with changes in repo borrowing, but did not find any evidence that it was systematically associated with changes in repo borrowing in the aggregate or with any particular counterparty type.

during the normal period, the average dealer would have used the average repo borrowing from the Fed to increase total borrowing by \$6.5 billion and that during the stress period, the average dealer would have used the average borrowing from the Fed to increase total repo borrowing by roughly the same amount. Thus, while there was more substitution away from borrowing during times of higher market stress, Fed repo usage was still associated with a net increase in dealers' total repo borrowing.

3.3 Effects on dealer repo lending

A similar exercise examines the other side of dealers' balance sheets to see how changes in dealers' repo lending were associated with their use of the Fed's repo operations. As dealers appear to have used some of the funds obtained from the Fed to expand their total repo borrowing, this analysis provides insight into how those additional funds were used.

Table 4 shows results from estimating equations (3) and (4). The results show that a notable share of funds that dealers borrowed from the Fed did appear to be, in turn, lent by the dealers to their own customers. For instance, outside of the high stress period, each \$1 increase in dealers' repo borrowing from the Fed corresponded to a \$0.53 increase in repo lending by dealers (column 1).¹³ Thus, a quarter of the time, Fed repo usage translated to at least a \$53 million daily increase in a given dealer's repo lending.¹⁴ In conjunction with Table 3, our findings suggest dealers used the Fed's operations to increase their repo book on both sides by large amounts. A decomposition of the increase in repo lending shows that almost half (\$0.23 of the \$0.53) went to banks (column 7), with significant increases in repo lending to other dealers (column 3) and asset managers (column 5) as well.

In contrast to results on dealer repo borrowing, we do not observe significant changes in the relationship between Fed repo usage and total dealer repo lending during the high stress period nor when average CDS levels are higher (rows 3 and 5), although the coefficients typically have

¹³The response of total repo lending by the dealers to a \$1 increase in borrowing from the Fed is slightly smaller than the response in total repo borrowing. We do not know how the remaining funds were used.

¹⁴The 75th percentile daily change in dealer Fed repo usage is \$100 million as shown in Table 2.

the expected negative sign. One reason for this is that the pass-through of Fed repo borrowing during the high stress period varied by counterparty type. For every \$1 increase in Fed repo usage, repo lending to dealer counterparties (column 3) decreased \$0.27 during the high stress period (for a net decline of \$0.05 per dollar), while repo lending to bank counterparties (column 7) actually increased an additional \$0.17 per dollar. Another reason for the insignificance in Table 4 is that the pass-through of Fed repo borrowing to dealer lending to counterparties during the high stress period depended substantially on whether the counterparties were affiliated with the dealer. We explore the effects of dealer counterparty affiliation on Fed repo pass-through in Section 6.

Lastly, Table 4 shows that dealers’ repo lending to asset managers decreased during the high stress period of March 12 to April 8 2020 (column 5) and when average CDS levels were generally higher (column 6). Some previous work, such as Kruttli, Monin, Petrasek, and Watugala (2021), find no reduction in dealer financing of hedge funds during March 2020 and a comparison makes a few illuminating points. Kruttli, et. al. (2021) look at month-end data and, as may be seen in Figure 3(b), dealer lending volumes at the end of March 2020 are similar to those at the end of February 2020. Our crisis indicator points to mid-March as when the crisis period starts. As seen in Figure 3(b), that was around the peak of dealer lending to asset managers. Thus dating the crisis is quite important. Moreover, Kruttli, et. al. (2021) find that hedge funds did reduce their borrowing from dealers, but that this was due to risk management decisions rather than constraints on coming from the dealers. As our results do not distinguish supply and demand effects, those results are also consistent. Hence looking at these sets of analysis together provides a more nuanced understanding of developments with respect to hedge fund borrowing from dealers.

4 Bidding behavior in Fed repo auctions

Our analysis in Section 3 focused on the quantity effects of Fed repo operations. In this section, we examine the prices that dealers were willing to pay for usage of Fed repo operations. In particular, we analyze the behavior of dealers who bid prices above the specified minimum bid rate for Fed operations and how that affected their repo borrowing and lending volumes. Jointly considering

the price and quantity effects allows for better identification of whether dealers' usage of Fed repo operations were driven by dealers' concerns about the funding being provided to them by the private sector investors versus seeking more funding from the Fed because the pricing was relatively cheap.

We estimate separate equations for total private repo borrowing and total private repo lending:

$$\Delta PrivateRepo_{i,t} = \beta * bidRateSpread_{i,t} + c + \mu_i + \epsilon_{i,t} \quad (5)$$

$$\Delta PrivateRepoLending_{i,t} = \beta * bidRateSpread_{i,t} + c + \mu_i + \epsilon_{i,t}, \quad (6)$$

where $\Delta PrivateRepo_{i,t}$ and $\Delta PrivateRepoLending_{i,t}$ are the daily change in the dollar amount of dealer i 's repo borrowing and repo lending, respectively, from all counterparties but excluding that with central banks. We estimate the dependent variable for the total amount of private repo borrowing or lending, and also separately for private repo borrowing or lending from the three major counterparty types. $bidRateSpread_{i,t}$ is the difference between dealer i 's bid rate for participation in Fed repo auctions on day t and the minimum specified bid rate for the auctions.

The results, shown in Table 5, are consistent with dealer usage of Fed repo operations being driven by supply-side effects. Column 1 indicates that every 1 percentage point that a dealer was willing to bid above the minimum bid rate for the Fed repo auctions was associated with a roughly \$20 billion drop in its total repo borrowing from private counterparties. In other words, there was greater substitution away from private counterparties at the dealers who bid more aggressively in Fed repo auctions. Most of the pullback in repo borrowing was from bank counterparties (column 4). This aggressive bidding behavior suggests that these dealers were more concerned with their funding than with the idea that they were using low-cost Fed liquidity to replace private sector funding. Consistent with this hypothesis, our data shows that the dealers who bid more above the minimum bid rate were awarded higher quantities in Fed repo auctions.

At the same time, as shown in column 5, there was not a significant relationship between a dealer's minimum bid rate spread and its total repo lending to its counterparties. This finding indicates that even dealers who bid more aggressively in Fed repo auctions, likely due to increased need for funding during times of market stress, did not pull back lending to their clients. Such dealers

were able to utilize funding from Fed repo operations to continue to lend to all major counterparty types, as *bidRateSpread* did not significantly affect their private repo lending volumes (columns 6 through 8).

Importantly, these results underscore the critical role that Fed repo operations played – they allowed the dealers who most needed the funding to substitute away more borrowing from the private repo market while enabling these dealers to pass on the funding from Fed repo operations to their clients, especially during times of funding market stress.

5 Effects of leverage ratio on balance sheets

An significant factor that may affect dealers’ balance sheets as well as the pass-through of funding from Fed repo operations are dealers’ regulatory constraints. In particular, dealers’ incentives to intermediate in Treasury markets can be impacted by capital regulations, such as the SLR requirement. Since the SLR is a non-risk weighted capital requirement, it is particularly affected by high-volume, low-risk activities such as Treasury market intermediation, and could lead to lower levels of dealer intermediation. Between April 2020 to March 2021, the Federal Reserve temporarily excluded Treasury holdings and reserves from the denominator of the SLR calculation in order to provide BHCs subject to the SLR rule increased flexibility to continue to act as financial intermediaries.¹⁵

We measure each dealer’s headroom above their regulatory constraint as *slrDistToMin*, the difference between its SLR and the minimum SLR requirement for its bank holding company (BHC), as specified in the Basel III Accord. We examine whether *slrDistToMin* affected changes in the total size of their repo book from using Fed repo operations, as well as the amount of on-lending they passed along to their counterparties from such funds.

¹⁵More headspace also means generally less levered, though the change in headspace coinciding with the temporary regulatory change connects this analysis to the SLR.

In particular, on the borrowing side of the balance sheet, we estimate two specifications:

$$\Delta Repo_{i,t} = \beta_1 \Delta fedRepo_{i,t} + \beta_2 slrDistToMin_{i,qtr(t)-1} + c + \mu_i + \epsilon_{i,t}, \quad (7)$$

$$\begin{aligned} \Delta Repo_{i,t} = & \beta_3 \Delta fedRepo_{i,t} + \beta_4 slrDistToMin_{i,qtr(t)-1} + \\ & \beta_5 \Delta fedRepo_{i,t} \times slrDistToMin_{i,qtr(t)-1} + c + \mu_i + \epsilon_{i,t}, \end{aligned} \quad (8)$$

where the value of *slrDistToMin* is from the previous quarter, to avoid a look-ahead bias in the regression.¹⁶

Equation (7) examines the effect of adding in regulatory constraints, while Equation (8) examines the effect of the interaction of regulatory constraints and dealers' Fed repo usage on repo borrowing. Like before, we report results on total repo borrowing as well as results for repo borrowing from dealers, asset managers, and bank counterparties. Since our sample period is from September 2019 to May 2020 and we examine SLR ratios from the previous quarter, SLR ratios during the temporary exclusion period are not included in our analysis.

The results on total repo borrowing are shown in Table 6. As seen in column (1), the addition of *slrDistToMin* to the regression specification does not significantly affect the coefficient on our primary explanatory variable, $\Delta fedRepo$, the change in a dealer's borrowing from the Fed's repo operations. In fact the coefficients for *slrDistToMin* in row 2 are insignificant for all regression specifications, indicating that dealers' regulatory constraint does not significantly affect dealers' total repo borrowing nor their borrowing from major counterparties, beyond what is already explained by changes in dealers' usage of Fed repo operations.

However, the interaction of dealers' regulatory constraint and changes in Fed repo usage is significant and positive (row 3), showing that dealers are more likely to use their borrowing from the Fed's repo operations to increase their repo book size the more regulatory headroom that they have. As shown in column (2), for every 1 percentage point increase in *slrDistToMin*, dealers

¹⁶The SLR calculation for a given quarter uses data through quarter-end. For BHCs in the Euro area and Japan, the quarter-end value is used. For BHCs in the U.S. and U.K., on-balance sheet items are measured as the daily average value within the quarter, while off-balance sheet items are measured as the average of the three month-ends within the quarter.

increased their total repo borrowing by an additional 14 cents for each dollar borrowed from the Fed’s repo operations. These results are generally consistent with the findings of Afonso, Cipriani, and Spada (2022), who find that money funds provided more funding to dealers when the dealers’ SLR were less binding.

In addition, while dealers used some of the funds from the Fed’s repo operations to shift borrowing away from other funding sources, having more space with respect to the regulatory threshold is associated with less substitution. Column (4) of Table 6 shows that there would have been significant substitution away in repo borrowing from other dealers (45 cents per dollar borrowed from the Fed), but this amount was offset by 7 cents per dollar for every 1 percentage point increase in dealers’ SLR headroom.

Table 7 shows the SLR interaction regression results from the lending side of the balance sheet, where the dependent variable, like in Table 4, is the daily change in a dealer’s total repo lending to all counterparties or by counterparty type. Similar to the borrowing side, it is the interaction of dealers’ regulatory constraint and changes in their Fed repo usage that matters (row 3), as opposed to simply the regulatory constraint (row 2). As shown in column (2), for every 1 percentage point increase in *slrDistToMin*, dealers increased their repo lending to their counterparties by an additional 12 cents for each dollar borrowed from the Fed’s repo operations, suggesting that the bulk of the 14 cent per dollar increase in total repo borrowing seen in Table 6 was used to increase on-lending to counterparties. In particular, this means that dealers with SLR headroom around the 75th percentile increased their repo lending to counterparties by about 69 cents more per dollar of Fed repo usage than dealers whose headroom is around the 25th percentile.

Overall, our findings indicate that dealers with a greater SLR buffer used more of their repo borrowing from the Fed to provide intermediation in Treasury markets. In particular, these dealers used the Fed’s repo operations to increase the size of their repo book by a larger amount as well as on-lent more of the funding to their counterparties. In additional analysis (not shown), the effects of the SLR constraint appear to be prevalent throughout our sample period, and were not unique to the high stress period in March 2020.

6 Dealer affiliation and Fed repo pass-through

In this section, we conduct analysis to better understand the channels through which dealers’ usage of the Fed’s repo operations affect changes in their repo borrowing and lending in the broader funding markets. In particular, we examine differences in the pass-through of funding to dealers’ internal (affiliated) and external (unaffiliated) sources of borrowing and lending.

Dealers also are critical for supplying liquidity support to non-affiliated institutions. We look to see whether these institutions were affected differently – did dealers focus on affiliates at the expense of these other institutions? We also control for market conditions and examine how dealers’ shifting from private funding markets to the Fed is affected when market conditions are volatile or strained, and how the substitution effects differ for affiliated versus unaffiliated counterparties. In addition, we test whether dealers’ distance from the SLR minimum requirement affects their usage of Fed repo operations differently for affiliated and unaffiliated counterparties.

6.1 Dealer repo borrowing by affiliation status

To further explore how the Fed’s repo shaped dealer borrowing, we look at how it related to dealer borrowing from affiliated and non-affiliated counterparties.

In Table 8, panel A, we regress daily changes in the total dollar amount of dealer repo borrowing from affiliated counterparties, as well as borrowing from affiliated counterparties separated by counterparty type, on each dealer’s daily change in dollars borrowed from the Fed’s repo operations ($\Delta fedRepo$). As in equations (1) and (2), we also regress on a high funding stress period dummy (*highStressCdsDummy*) or average CDS levels across our 10 GSIB dealers (*avgCds*).

The results show that Fed repo usage did not significantly affect dealers’ total repo borrowing from affiliated counterparties, including during periods of high market stress. As seen in Figure 4(a), repo borrowing from affiliated counterparties (red line) was largely flat during the high stress period and in general exhibits little variation over the sample period. We do observe a statistically significant but small reduction in repo borrowing from affiliated asset managers, by eight cents on

the dollar (column 5).¹⁷

In panel B of Table 8, we control for dealers’ distance from the SLR minimum, as we did in equations (7) and (8). Similar to our results in Section 5, adding *slrDistToMin* does not significantly affect the coefficients on $\Delta fedRepo$, as shown in column 1, and the coefficients on *slrDistToMin* are insignificant for all counterparty types, as shown in row 2. Like before, the interaction between *slrDistToMin* and $\Delta fedRepo$ is positive and significant, showing that dealers who had more headroom above the SLR minimum were less likely to substitute away from repo borrowing from affiliated counterparties. As shown in column (2), a dealer who had zero headroom above their SLR minimum would decrease their borrowing from affiliated counterparties by 27 cents for each dollar borrowed from the Fed. As dealers’ distance from the minimum increases, the substitution effect lessens – for every 1 percentage point increase in *slrDistToMin*, dealers’ substitution away in borrowing from affiliates is offset by 5 cents for each dollar borrowed from the Fed. This effect is most pronounced for affiliated asset manager counterparties, as shown in column (6).

Turning to external sources of borrowing, in Table 9, panel A, we regress daily changes in the total dollar amount of dealer repo borrowing from unaffiliated counterparties, as well as borrowing from unaffiliated counterparties separated by counterparty type, on the same explanatory variables.

The results indicate that dealers also substituted away borrowing from external sources, but unlike results for internal repo, reductions in external repo borrowing were most pronounced during periods of high market stress. In particular, for every \$1 increase in Fed repo usage, dealers decreased repo borrowing from their unaffiliated counterparties by \$0.13, and by an additional \$0.35 per dollar during the high stress period (column 1). From the beginning of the high stress period on March 12 to the peak of dealers’ Fed repo usage on March 17, the average dealer in our sample increased its daily Fed repo usage from \$14 billion to \$25 billion, which translates to a reduction of \$5.3 billion in

¹⁷While FR2052a filers do not report the names of unaffiliated counterparties, they are required to specify the names of affiliated counterparties. This field provides additional insight into what types of affiliated counterparties are included in each category: affiliated dealers are most often overseas dealer branches, but they can also be smaller domestic dealer subsidiaries; affiliated asset managers are often the wealth management division of the firm, but international holding companies are sometimes also included in this category; affiliated banks are generally domestic or foreign depository institutions.

borrowing from unaffiliated counterparties. This reduction suggests that dealers, who typically use external funding, did so less during times of market stress as the Fed expanded its repo operations. Here it is particularly important to re-iterate that we cannot distinguish between whether dealers found the Fed to be a more attractive counterparty or were forced to turn to the Fed because their regular sources of funding became less available.

Furthermore, the effect of CDS on dealers' external repo borrowing holds not just during times of market stress, but is proportional to average CDS levels across dealers. For every \$1 increase in Fed repo usage and 1 percentage point increase in average CDS spreads, dealers decreased repo borrowing from their unaffiliated counterparties by \$0.41 (column 2). The decomposition of the effects by counterparty type reveal that dealers mainly substituted away from repo with other unaffiliated dealers (columns 3 and 4), suggesting that the Fed had a sizeable impact on the composition of dealers' repo counterparties for a couple of weeks as dealers drew back from other external term funding.

In panel B of Table 9, we control for dealers' distance from the SLR minimum requirement. Even more so than for affiliated counterparties, we find that the substitution effect for unaffiliated counterparties is stronger for dealers who are closer to the SLR minimum. As seen in column (2), a dealer who had zero headroom above their SLR minimum would decrease their borrowing from unaffiliated counterparties by 52 cents for each dollar borrowed from the Fed (a magnitude almost double that for affiliated counterparties). The interaction between *slrDistToMin* and $\Delta fedRepo$ is positive and significant for dealers' total repo borrowing from unaffiliated counterparties. For every 1 percentage point increase in *slrDistToMin*, dealers' substitution away from unaffiliated counterparties is mitigated by 9 cents. In particular, the mitigation effect is most pronounced for dealer borrowing from unaffiliated dealer counterparties (column 4).

6.2 Dealer repo lending by affiliation status

Finally, we examine the effect of the Fed's repo operations on the amount of lending dealers provide to their counterparties based on affiliation. We regress daily changes in the dollar amount of dealer

repo lending to affiliated or unaffiliated counterparties, on each dealer’s daily change in dollars borrowed from the Fed’s repo operations.

Tables 10 and 11 shed light on the share of the increase in dealers’ repo lending going to each counterparty type. Outside of the high stress period, \$0.23 of the \$0.53 of the increase per dollar in total repo lending went to affiliated counterparties (Table 10, panel A, column 1), where affiliated banks account for all of this increase (column 7). The remainder of the increase in dealer repo lending (\$0.30 of the \$0.53) went to unaffiliated counterparties (Table 11, panel A, column 1), where the majority went to other unaffiliated dealers (column 3). For example, if a dealer increased its Fed repo borrowing by \$100 million (the 75th percentile for $\Delta fedRepo$ in our sample), we estimate that it would increase its repo lending to affiliated counterparties by about \$23 million and to unaffiliated counterparties by about \$30 million.

In contrast, during the high stress period that began in mid-March 2020 (row 3), there were signs of a pullback from external capital markets, with those funds being shifted towards internal capital markets. While we observed in Table 4 that, on net, the total amount of dealer on-lending to all counterparties did not change during the high stress period, Tables 10 and 11 reveal there was a significant shift in the composition of counterparty types that the funds were lent to. In particular, the amount of dealer on-lending to affiliated counterparties *increased* by an additional \$0.22 per dollar during the high stress period (Table 10, panel A, column 1), while the amount of dealer on-lending to unaffiliated counterparties *decreased* by an additional \$0.37 per dollar (Table 11, panel A, column 1). This composition shift in repo lending from unaffiliated counterparties to affiliated counterparties can also be seen in Figure 4(b), with most of the lending increase to affiliated counterparties occurring in the early part of the high stress period.

Moreover, while dealers were still on-lending funds received from the Fed during the high stress period, nearly all of the on-lending went to their affiliated banks (Table 10, column 7), while on-lending was being pulled away from unaffiliated dealers (Table 11, column 3). From the beginning of the high stress period to the peak of dealers’ Fed repo usage, our estimates suggest that the average dealers’ increase of \$11 billion in Fed repo borrowing would be associated with on-lending of an additional \$4.3 billion to affiliated banks, while on-lending to unaffiliated dealers would decrease by

about \$1.1 billion.

Our second regression specification in panel A includes average CDS levels across dealers as an explanatory variable, as well as its interaction with changes in dealer Fed repo usage. As seen in Table 9, when average CDS is higher, there is less pass-through of Fed repo to GSIB dealers' external counterparties (column 2). However, dealers appear to be indifferent to average CDS levels when it comes to on-lending to their internal affiliates (Table 10). In other words, funding market condition proxies such as average CDS did not significantly affect dealer lending to their affiliate counterparties.

Panel B of Tables 10 and 11 includes dealers' distance from the minimum SLR requirement as an explanatory variable, as well as its interaction with changes in dealer Fed repo usage. While the coefficients on *slrDistToMin* are insignificant (row 2), the interaction with $\Delta fedRepo$ is significant for both affiliated and unaffiliated counterparties, suggesting that dealers are more likely to on-lend to both counterparty types when they have more headroom above the SLR. The magnitude of the effect is similar – for every 1 percentage point increase in *slrDistToMin*, dealers' increase on-lending to affiliated counterparties and unaffiliated counterparties by \$0.06 each (Tables 10 and 11, panel B, column 2). As noted earlier, the on-lending to affiliates is mainly to banks (Table 10, panel B, column 8), while the on-lending to non-affiliates is mainly to dealers (Table 11, panel B, column 4).

7 Conclusion

In this paper we examine how primary dealers utilized repo operations conducted by the Fed and how it affected their balance sheets. We explore how that funding affected their balance sheets on both the lending and borrowing side, and how it affected the funding to and from dealers' counterparties.

Our results indicate that the Federal Reserve repo operations were very important to dealers during financial stress. Dealer bidding at Fed repo auctions is most consistent with the hypothesis

that dealers made more use of Fed liquidity when they were concerned about their own funding. Our results support the idea that the use of these operations reduced the stress on dealers. Moreover, we find that dealers passed on this liquidity, with much of it to their affiliated entities. In a stress event any pass-through supports financial market functioning especially given the systemic importance of the bank holding companies of which the dealers are a part of.

Our results have important implications for the benefits of the standing repo facility (SRF) established by the Federal Reserve in 2021. Following the 2008 financial crisis and the disruptions to the Treasury and repo market in 2020, there were proposals for liquidity backstops to be established for the repo market (Dudley, 2013; Liang and Parkinson, 2020). Providing a liquidity backstop for the Treasury repo market to prevent pressures in that market from spilling over into other markets was one motivation that Federal Reserve policymakers referenced when deciding in 2021 to establish the SRF. The SRF should promote liquidity in the repo market by reassuring market participants that liquidity can be effectively supplied through the facility should it be needed. Our results, which indicate that the liquidity provided by the Federal Reserve was transmitted by the dealers to the broad financial market to others, provide compelling empirical support that the SRF could be effective as part of the Federal Reserve’s response to financial stresses in the future.

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Figures and Tables

A Figures

Figure 1: Federal Reserve Repo Outstanding

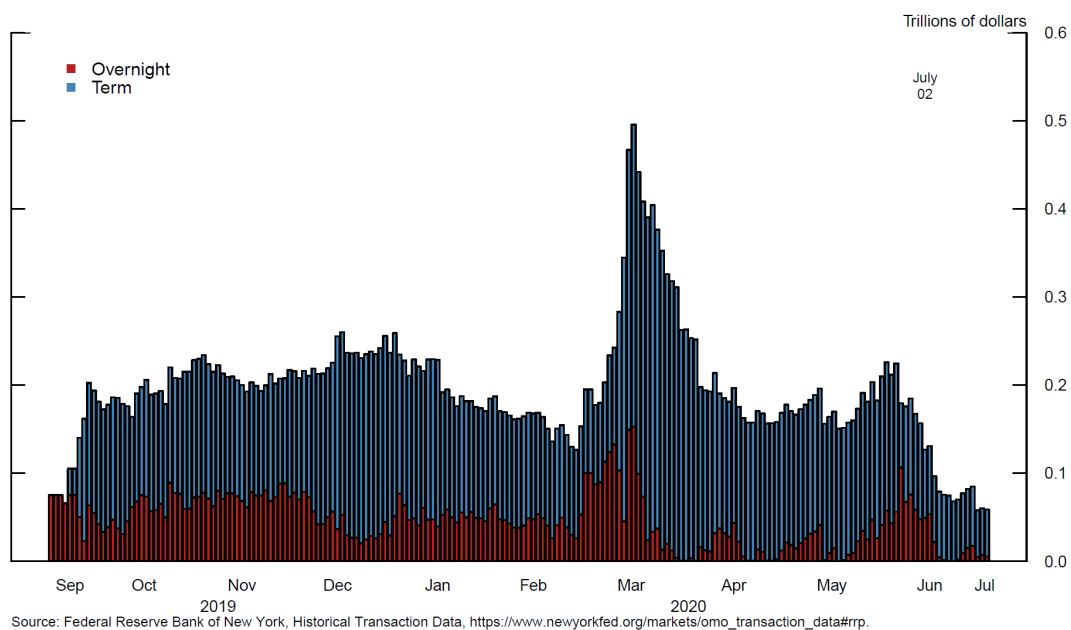


Figure 1 plots the daily frequency of total volume outstanding of overnight (red bars) and term Fed repo (blue bars) for all primary dealers from September 2019 to July 2020.

Figure 2: Average CDS spread across GSIB Dealers

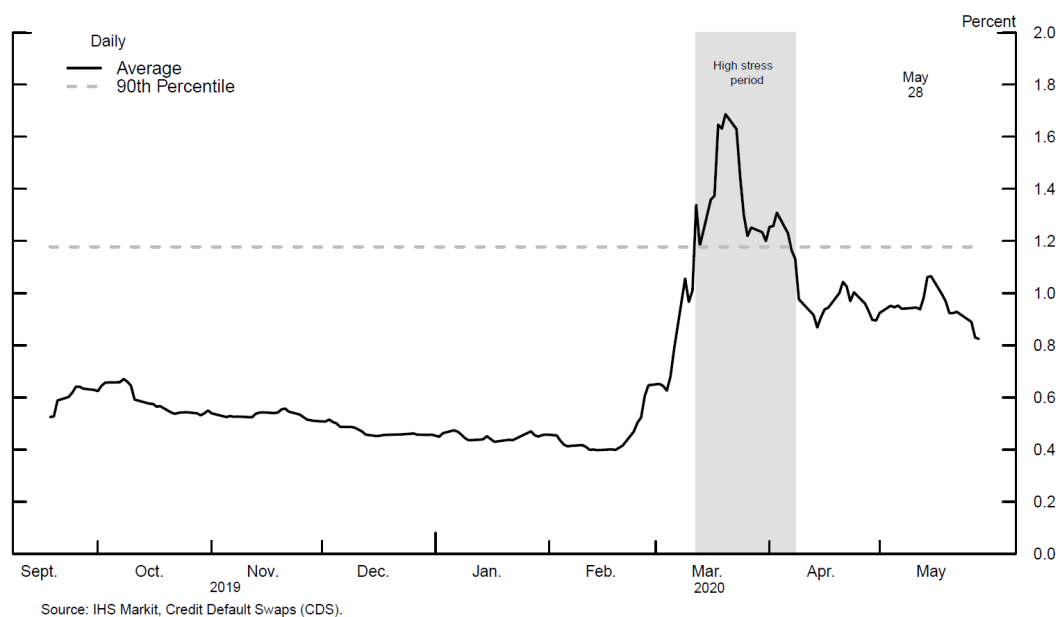


Figure 2 plots the average CDS spread of the primary dealer subsidiaries of the ten GSIBs in our sample from September 2019 to May 2020. The high stress period, represented by the gray shaded area, is defined to be the period when the average CDS spread was above its 90th percentile, delineated by the horizontal dashed line.

Figure 3: Dealer Repo Activity by Counterparty Type

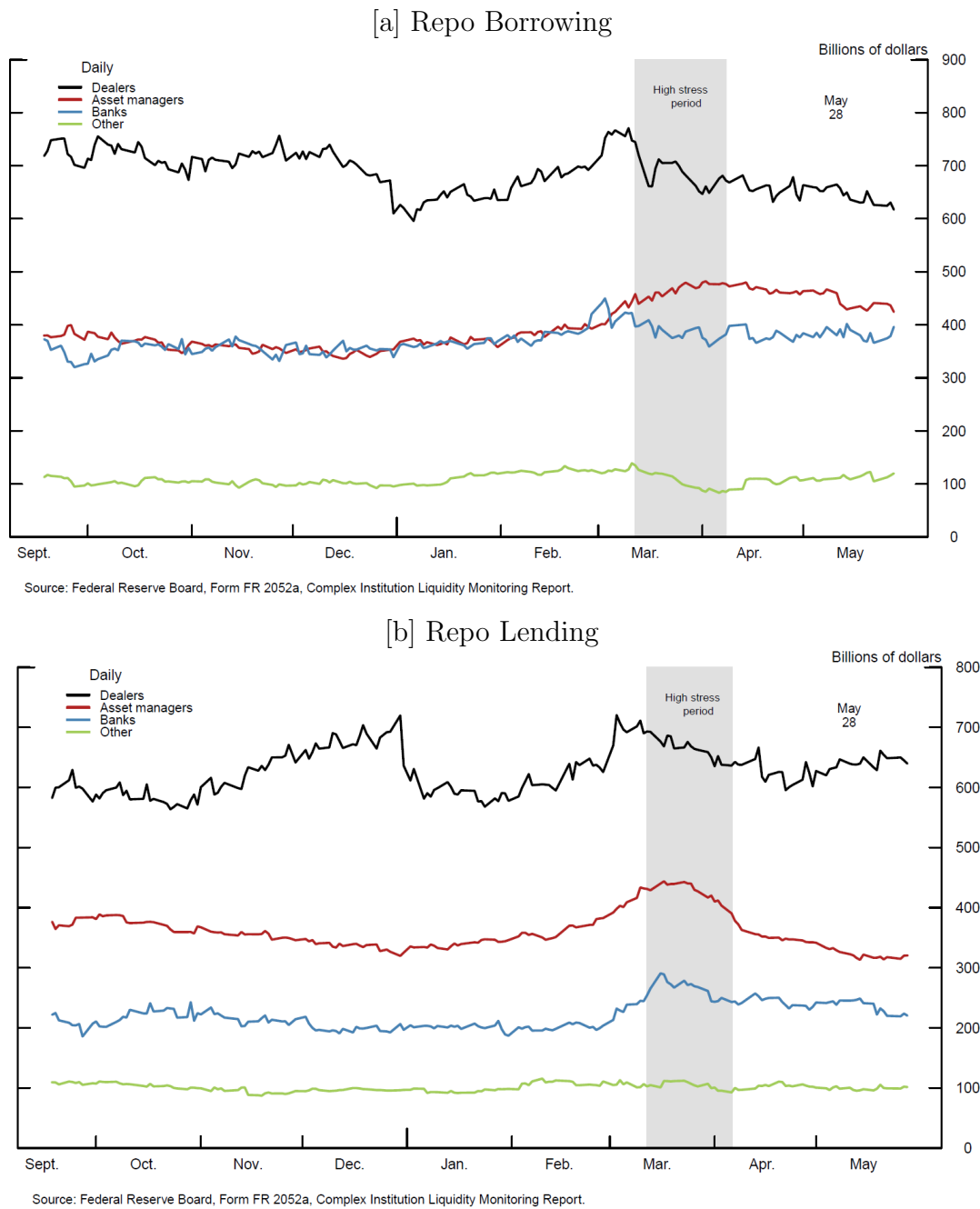


Figure 3 plots the repo activity by counterparty type of the 10 GSIB dealers in our sample from September 2019 to May 2020. The four counterparty types that are shown are dealers (black line), asset managers (red line), banks (blue line), and other (green line). Panel A shows volumes of repo borrowing, while Panel B shows volumes of repo lending. The high stress period is shaded in both panels and covers the period March 12 to April 8, 2020.

Figure 4: Dealer Repo Activity with Affiliated and Unaffiliated Counterparties

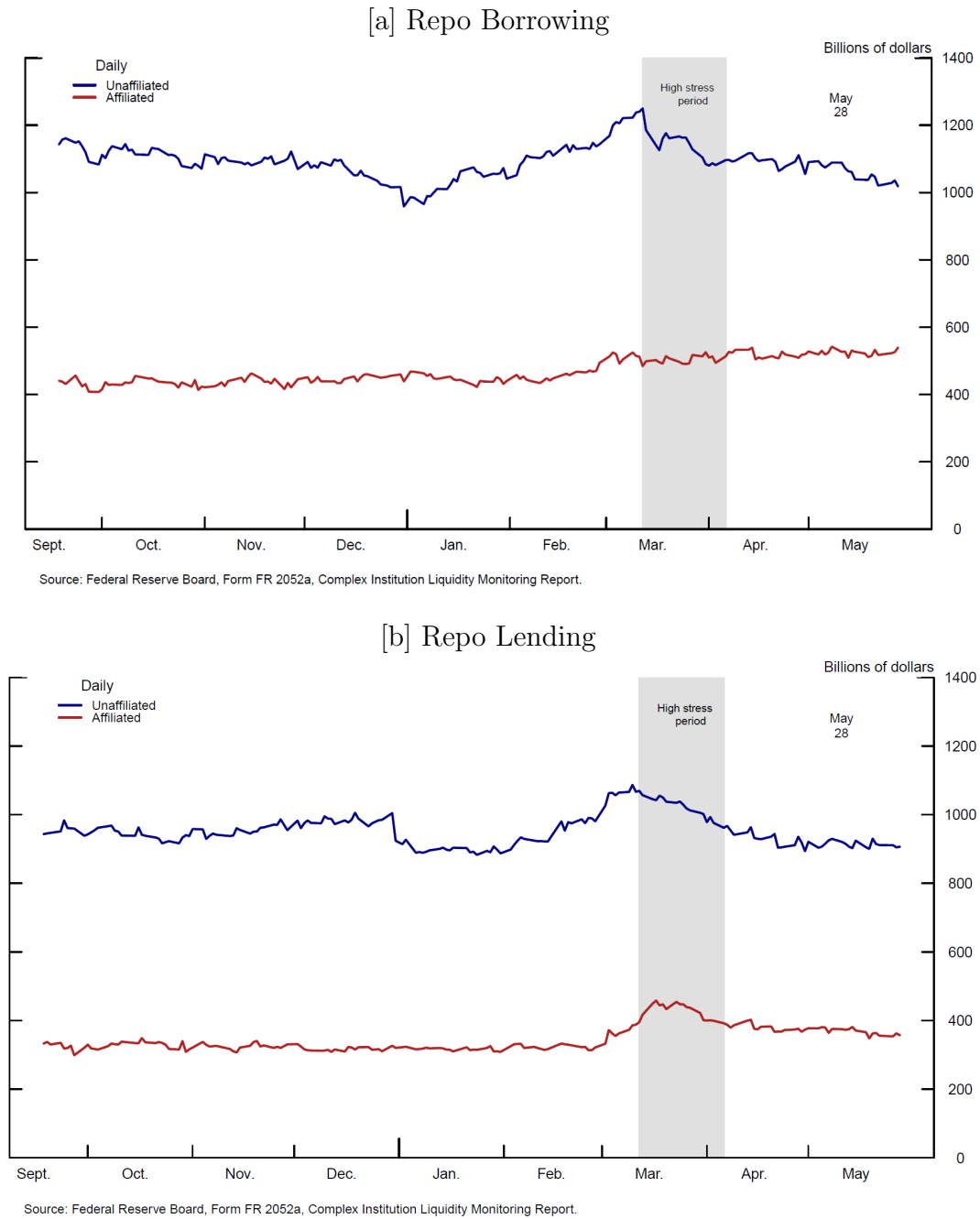


Figure 4 plots the repo activity with affiliated and unaffiliated counterparties of the 10 GSIB dealers in our sample from September 2019 to May 2020. Panel A shows volumes of repo borrowing, while Panel B shows volumes of repo lending. The high stress period is shaded in both panels and covers the period March 12 to April 8, 2020.

B Tables

Table 1: Average Daily Fed Repo Outstanding for Large Dealers (\$ billions)

Dealer	Pre-COVID	Post-COVID	High-stress
JPMorganChase	25.17	26.70	38.28
GoldmanSachs	20.12	21.02	35.06
Citigroup	14.68	23.02	24.10
DeutscheBank	14.42	6.10	7.96
Barclays	12.89	16.93	30.79
BankofAmerica	6.68	9.37	13.60
MorganStanley	2.84	0.53	1.38
CreditSuisse	1.79	4.71	8.64
UBS	1.43	0.32	0.12
WellsFargo	1.14	4.32	6.60

Table 1 shows the average daily Fed repo outstanding amounts in billions of dollars for the primary dealer subsidiaries of the ten GSIBs in our sample, using public data from FRBNY historical transaction data for repo and reverse repo. The pre-Covid period is from September 18, 2019 to February 14, 2020.

The post-COVID period is from February 15, 2020 to May 28, 2020. The high-stress period is from March 12, 2020 to April 8, 2020.

Table 2: Summary Statistics of Dealer-level Variables

Statistic	N	Mean	St. Dev.	Pctl(25)	Pctl(75)
<i>fedRepo</i> (\$bn)	1,730	10.60	10.73	1.50	17.67
<i>Repo</i> (\$bn)	1,730	168.55	132.60	91.75	208.61
<i>ReverseRepo</i> (\$bn)	1,730	131.26	109.21	56.19	146.59
$\Delta fedRepo$ (\$bn)	1,720	0.04	2.79	−0.003	0.10
$\Delta Repo$ (\$bn)	1,720	0.03	6.11	−2.93	2.86
$\Delta ReverseRepo$ (\$bn)	1,720	−0.005	5.77	−2.74	2.74
<i>dealerCDS</i> (percent)	1,730	0.70	0.45	0.40	0.90
<i>slrDistToMin</i> (percent)	40	4.15	3.26	1.52	7.35

Table 2 shows summary statistics of the key dealer-level variables used in the paper between September 18, 2019 to May 28, 2020. *fedRepo* is each dealer’s daily outstanding amount borrowed through Fed repo operations, calculated from data collected by FRBNY. *Repo* is each dealer’s daily outstanding total repo borrowing from all counterparties, including through Fed repo operations, calculated from the FR 2052a Complex Institution Liquidity Monitoring Report. *ReverseRepo* is each dealer’s daily outstanding total repo lending to all counterparties, calculated from the FR 2052a Complex Institution Liquidity Monitoring Report. *dealerCDS* is each dealer’s CDS spread from Markit CDS pricing data. *slrDistToMin* is the difference between the dealer’s Supplementary Leverage Ratio (SLR), which is calculated from the FR Y-9 data and banks’ Call Reports, and the minimum SLR requirement as specified in the Basel III accord. All variables are available at a daily frequency, with the exception of the SLR which is available at a quarterly frequency.

Table 3: **Effect of Fed repo usage on dealer repo borrowing**

This table shows the results from panel regressions in equations 1 and 2. $\Delta Repo$, the dependent variable, is the daily change in each dealer's repo volume across different counterparties (total, dealers, asset managers, and banks). The total columns include repo with central banks. $\Delta fedRepo$ is the daily change in each dealers' outstanding volume of borrowing from Fed repo operations. $avgCds$ is the average CDS price of the dealers in our sample. $highStressCdsDummy$ is equal to one when $avgCds$ is above the 90th percentile, relative to its historical distribution. The sample period is September 18, 2019 to May 28, 2020.

	$\Delta Repo$							
	Total		Dealer		AM		Bank	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta fedRepo$	0.76*** (0.08)	0.99*** (0.18)	-0.13** (0.06)	0.11 (0.14)	-0.04 (0.04)	-0.03 (0.09)	-0.01 (0.05)	-0.06 (0.12)
$highStressCdsDummy$	-0.87 (0.56)		-0.45 (0.44)		0.16 (0.29)		-0.32 (0.34)	
$\Delta fedRepo:highStressCdsDummy$	-0.36** (0.16)		-0.29 (0.18)		-0.05 (0.11)		0.00 (0.13)	
$avgCds$		-0.64 (0.50)		-0.38 (0.41)		0.08 (0.25)		-0.21 (0.32)
$\Delta fedRepo:avgCds$		-0.38* (0.21)		-0.38* (0.20)		-0.04 (0.12)		0.06 (0.15)
Observations	1720	1720	1720	1720	1720	1720	1720	1720

Note: Firm fixed effects and heteroskedasticity robust standard errors.

Table 4: **Effect of Fed repo usage on dealer repo lending**

This table shows the results from panel regressions in equations 3 and 4. $\Delta ReverseRepo$, the dependent variable, is the daily change in each dealer's reverse repo volume across different counterparties (total, dealers, asset managers, and banks). The total columns include reverse repo with central banks. $\Delta fedRepo$ is the daily change in each dealers' outstanding volume of borrowing from Fed repo operations. $avgCds$ is the average CDS price of the dealers in our sample. $highStressCdsDummy$ is equal to one when $avgCds$ is above the 90th percentile, relative to its historical distribution. The sample period is September 18, 2019 to May 28, 2020.

	$\Delta ReverseRepo$							
	Total		Dealer		AM		Bank	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta fedRepo$	0.53*** (0.08)	0.69*** (0.18)	0.22*** (0.07)	0.35** (0.15)	0.08*** (0.02)	0.13*** (0.04)	0.23*** (0.04)	0.21** (0.09)
$highStressCdsDummy$	-0.59 (0.50)		-0.36 (0.41)		-0.21 (0.16)		0.07 (0.23)	
$\Delta fedRepo:highStressCdsDummy$	-0.16 (0.16)		-0.27** (0.13)		-0.05 (0.04)		0.17* (0.10)	
$avgCds$		-0.63 (0.47)		-0.32 (0.41)		-0.26* (0.14)		-0.01 (0.19)
$\Delta fedRepo:avgCds$		-0.24 (0.19)		-0.24 (0.16)		-0.07 (0.05)		0.08 (0.10)
Observations	1720	1720	1720	1720	1720	1720	1720	1720

Note: Firm fixed effects and heteroskedasticity robust standard errors.

Table 5: Effect of Fed Repo Bid Rate Spread on Changes in Private Repo Borrowing and Lending

This table shows the results from panel regressions in equations 5 and 6, which explore how the bid rates on Fed repo are related to dealers' repo borrowing and lending from private (non-Fed) counterparties. In columns (1) to (4), the dependent variable is $\Delta PrivateRepo$, the daily change in each dealer's repo volume across different counterparties (total, dealers asset managers, and banks). In columns (5) to (8), the dependent variable is $\Delta PrivateReverseRepo$, the daily change in each dealer's reverse repo volume across different counterparties. $bidRateSpread$ is the difference between the rate that each dealer bid in Fed repo auctions on a given day and the minimum rate for that day. The sample period is September 18, 2019 to May 28, 2020.

	$\Delta PrivateRepo$				$\Delta PrivateReverseRepo$			
	Total	Dealer	AM	Bank	Total	Dealer	AM	Bank
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>bidRateSpread</i>	-20.53**	-1.94	-3.09	-16.57***	-3.74	0.90	-2.81	0.62
	(9.22)	(7.45)	(3.97)	(5.99)	(9.08)	(7.40)	(2.57)	(4.42)
Observations	859	859	859	859	859	859	859	859

Table 6: **Effect of Fed repo usage on dealer repo borrowing, with SLR interaction**

This table shows the results from panel regressions in equations 7 and 8. $\Delta Repo$, the dependent variable, is the daily change in each dealer's repo volume across different counterparties (total, dealers, asset managers, and banks). The total columns include repo with central banks. $\Delta fedRepo$ is the daily change in each dealers' outstanding volume of borrowing from Fed repo operations. $slrDistToMin$ is the difference between each dealer's SLR and the minimum SLR requirement. The sample period is September 18, 2019 to May 28, 2020.

	$\Delta Repo$							
	Total - All CP		Dealer		AM		Bank	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta fedRepo$	0.67*** (0.07)	0.20* (0.11)	-0.21*** (0.06)	-0.45*** (0.11)	-0.05 (0.04)	-0.15** (0.07)	-0.00 (0.05)	-0.10 (0.07)
$slrDistToMin$	0.18 (0.27)	0.17 (0.27)	0.06 (0.18)	0.06 (0.18)	0.05 (0.07)	0.04 (0.07)	0.06 (0.16)	0.05 (0.16)
$\Delta fedRepo : slrDistToMin$		0.14*** (0.02)		0.07*** (0.02)		0.03** (0.01)		0.03* (0.02)
Observations	1720	1720	1720	1720	1720	1720	1720	1720

Note: Firm fixed effects and heteroskedasticity robust standard errors.

Table 7: **Effect of Fed repo usage on dealer repo lending, with SLR interaction**

This table shows the results from panel regressions estimating the effect of Fed repo usage and the SLR headroom on dealer repo lending. $\Delta ReverseRepo$, the dependent variable, is the daily change in each dealers' reverse repo volume across different counterparties (total, dealers, asset managers, and banks). The total columns include reverse repo with central banks. $\Delta fedRepo$ is the daily change in each dealers' outstanding volume of borrowing from Fed repo operations. $slrDistToMin$ is the difference between each dealers' SLR and the minimum SLR requirement. The sample period is September 18, 2019 to May 28, 2020.

	$\Delta ReverseRepo$							
	Total - All CP			Dealer		AM		Bank
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta fedRepo$	0.49*** (0.07)	0.09 (0.11)	0.15** (0.06)	-0.03 (0.11)	0.07*** (0.02)	0.05* (0.03)	0.27*** (0.04)	0.07* (0.04)
$slrDistToMin$	0.04 (0.24)	0.04 (0.24)	-0.04 (0.17)	-0.05 (0.16)	0.04 (0.06)	0.04 (0.06)	0.03 (0.15)	0.03 (0.15)
$\Delta fedRepo:slrDistToMin$		0.12*** (0.02)		0.05*** (0.02)		0.01 (0.01)		0.06*** (0.01)
Observations	1720	1720	1720	1720	1720	1720	1720	1720

Note: Firm fixed effects and heteroskedasticity robust standard errors.

Table 8: **Effect of Fed repo usage on dealer repo borrowing from affiliated counterparties**

These tables explore how the Fed's repo operations are related to dealer borrowing from affiliated counterparties. Panel [A] shows the results from panel regressions with a high stress period interaction. Panel [B] shows the results from panel regressions with the SLR interaction. $\Delta Repo$, the dependent variable, is the daily change in each dealer's repo volume across different affiliated counterparties (total, dealers, asset managers, and banks). $\Delta fedRepo$ is the daily change in each dealers' outstanding volume of borrowing from Fed repo operations. $avgCds$ is the average CDS price of the dealers in our sample. $highStressCdsDummy$ is equal to one when $avgCds$ is above the 90th percentile, relative to its historical distribution. $slrDistToMin$ is the difference between each dealer's SLR and the minimum SLR requirement. The sample period is September 18, 2019 to May 28, 2020.

[A] High stress period interaction

	$\Delta Repo$							
	Total	Affiliated	Dealer		AM		Bank	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta fedRepo$	-0.10 (0.06)	-0.12 (0.15)	-0.01 (0.02)	0.03 (0.06)	-0.08*** (0.03)	-0.11 (0.08)	-0.01 (0.04)	-0.04 (0.12)
$highStressCdsDummy$	-0.01 (0.39)		-0.01 (0.16)		0.20 (0.21)		-0.20 (0.32)	
$\Delta fedRepo : highStressCdsDummy$	0.03 (0.15)		-0.03 (0.08)		0.04 (0.10)		0.01 (0.12)	
$avgCds$		-0.03 (0.36)		0.01 (0.15)		0.17 (0.19)		-0.22 (0.31)
$\Delta fedRepo : avgCds$		0.04 (0.18)		-0.07 (0.08)		0.06 (0.11)		0.05 (0.15)
Observations	1720	1720	1720	1720	1720	1720	1720	1720

Note: Firm fixed effects and heteroskedasticity robust standard errors.

[B] SLR Interaction

	$\Delta Repo$							
	Total	Affiliated	Dealer		AM		Bank	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta fedRepo$	-0.09 (0.06)	-0.27*** (0.10)	-0.02 (0.03)	-0.05 (0.05)	-0.07** (0.03)	-0.13** (0.06)	0.00 (0.05)	-0.09 (0.07)
$slrDistToMin$	0.04 (0.17)	0.04 (0.16)	-0.01 (0.03)	-0.01 (0.03)	0.02 (0.04)	0.02 (0.04)	0.03 (0.16)	0.03 (0.16)
$\Delta fedRepo : slrDistToMin$		0.05*** (0.02)		0.01 (0.01)		0.02** (0.01)		0.03* (0.02)
Observations	1720	1720	1720	1720	1720	1720	1720	1720

Note: Firm fixed effects and heteroskedasticity robust standard errors.

Table 9: **Effect of Fed repo usage on dealer repo borrowing from unaffiliated counterparties**

These tables explore how the Fed's repo operations are related to dealer borrowing from unaffiliated counterparties. Panel [A] shows the results from panel regressions with a high stress period interaction. Panel [B] shows the results from panel regressions with the SLR interaction. $\Delta Repo$, the dependent variable, is the daily change in each dealer's repo volume across different unaffiliated counterparties (total, dealers, asset managers, and banks). $\Delta fedRepo$ is the daily change in each dealers' outstanding volume of borrowing from Fed repo operations. $avgCds$ is the average CDS price of the dealers in our sample. $highStressCdsDummy$ is equal to one when $avgCds$ is above the 90th percentile, relative to its historical distribution. $slrDistToMin$ is the difference between each dealer's SLR and the minimum SLR requirement. The sample period is September 18, 2019 to May 28, 2020.

[A] High stress period interaction

	$\Delta Repo$							
	Total Unaffiliated		Dealer		AM		Bank	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta fedRepo$	-0.13** (0.06)	0.11 (0.14)	-0.12** (0.05)	0.08 (0.12)	0.04* (0.02)	0.09** (0.04)	-0.00 (0.01)	-0.02 (0.02)
$highStressCdsDummy$	-0.90* (0.49)		-0.45 (0.42)		-0.04 (0.18)		-0.05 (0.06)	
$\Delta fedRepo:highStressCdsDummy$	-0.35** (0.16)		-0.26* (0.14)		-0.09** (0.05)		-0.01 (0.02)	
$avgCds$		-0.68 (0.43)		-0.40 (0.38)		-0.09 (0.16)		0.01 (0.06)
$\Delta fedRepo:avgCds$		-0.41** (0.18)		-0.32** (0.15)		-0.09* (0.06)		0.02 (0.02)
Observations	1720	1720	1720	1720	1720	1720	1720	1720

Note: Firm fixed effects and heteroskedasticity robust standard errors.

[B] SLR Interaction

	$\Delta Repo$							
	Total Unaffiliated		Dealer		AM		Bank	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta fedRepo$	-0.23*** (0.06)	-0.52*** (0.10)	-0.19*** (0.05)	-0.41*** (0.09)	0.01 (0.02)	-0.02 (0.04)	-0.00 (0.01)	-0.01 (0.02)
$slrDistToMin$	0.14 (0.21)	0.14 (0.20)	0.07 (0.18)	0.07 (0.18)	0.02 (0.06)	0.02 (0.06)	0.03 (0.03)	0.03 (0.03)
$\Delta fedRepo:slrDistToMin$		0.09*** (0.02)		0.06*** (0.02)		0.01 (0.01)		0.00 (0.00)
Observations	1720	1720	1720	1720	1720	1720	1720	1720

Note: Firm fixed effects and heteroskedasticity robust standard errors.

Table 10: **Effect of Fed repo usage on dealer repo lending to affiliated counterparties**

These tables explore how the Fed's repo operations are related to dealer lending to affiliated counterparties. Panel [A] shows the results from panel regressions with a high stress period interaction. Panel [B] shows the results from panel regressions with the SLR interaction. $\Delta ReverseRepo$, the dependent variable, is the daily change in each dealer's reverse repo volume across different affiliated counterparties (total, dealers, asset managers, and banks). $\Delta fedRepo$ is the daily change in each dealers' outstanding volume of borrowing from Fed repo operations. $avgCds$ is the average CDS price of the dealers in our sample. $highStressCdsDummy$ is equal to one when $avgCds$ is above the 90th percentile, relative to its historical distribution. $slrDistToMin$ is the difference between each dealer's SLR and the minimum SLR requirement. The sample period is September 18, 2019 to May 28, 2020.

[A] High stress period interaction

	$\Delta ReverseRepo$							
	Total Affiliated		Dealer		AM		Bank	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta fedRepo$	0.23*** (0.05)	0.18* (0.09)	-0.00 (0.02)	-0.02 (0.05)	0.00** (0.00)	0.00 (0.01)	0.22*** (0.04)	0.20** (0.09)
$highStressCdsDummy$	0.09 (0.26)		0.06 (0.12)		-0.03 (0.08)		0.06 (0.23)	
$\Delta fedRepo:highStressCdsDummy$	0.22** (0.10)		0.05 (0.04)		0.00 (0.01)		0.17* (0.10)	
$avgCds$		0.03 (0.22)		0.07 (0.11)		-0.02 (0.07)		-0.01 (0.19)
$\Delta fedRepo:avgCds$		0.13 (0.10)		0.04 (0.04)		0.00 (0.01)		0.08 (0.10)
Observations	1720	1720	1720	1720	1720	1720	1720	1720

Note: Firm fixed effects and heteroskedasticity robust standard errors.

[B] SLR Interaction

	$\Delta ReverseRepo$							
	Total Affiliated		Dealer		AM		Bank	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta fedRepo$	0.28*** (0.04)	0.08 (0.05)	0.01 (0.02)	0.00 (0.04)	0.01** (0.00)	0.01** (0.00)	0.27*** (0.04)	0.06 (0.04)
$slrDistToMin$	0.02 (0.15)	0.02 (0.15)	-0.00 (0.02)	-0.00 (0.02)	0.01 (0.02)	0.01 (0.02)	0.02 (0.15)	0.02 (0.15)
$\Delta fedRepo:slrDistToMin$		0.06*** (0.01)		0.00 (0.01)		-0.00** (0.00)		0.06*** (0.01)
Observations	1720	1720	1720	1720	1720	1720	1720	1720

Note: Firm fixed effects and heteroskedasticity robust standard errors.

Table 11: **Effect of Fed repo usage on dealer repo lending to unaffiliated counterparties**

These tables explore how the Fed's repo operations are related to dealer lending to unaffiliated counterparties. Panel [A] shows the results from panel regressions with a high stress period interaction. Panel [B] shows the results from panel regressions with the SLR interaction. $\Delta ReverseRepo$, the dependent variable, is the daily change in each dealer's reverse repo volume across different unaffiliated counterparties (total, dealers, asset managers, and banks). $\Delta fedRepo$ is the daily change in each dealers' outstanding volume of borrowing from Fed repo operations. $avgCds$ is the average CDS price of the dealers in our sample. $highStressCdsDummy$ is equal to one when $avgCds$ is above the 90th percentile, relative to its historical distribution. $slrDistToMin$ is the difference between each dealer's SLR and the minimum SLR requirement. The sample period is September 18, 2019 to May 28, 2020.

[A] High stress period interaction

	$\Delta ReverseRepo$							
	Total Unaffiliated		Dealer		AM		Bank	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta fedRepo$	0.30*** (0.07)	0.50*** (0.17)	0.22*** (0.07)	0.37** (0.16)	0.08*** (0.02)	0.12*** (0.04)	0.01 (0.00)	0.01 (0.01)
$highStressCdsDummy$	-0.62 (0.44)		-0.43 (0.41)		-0.18 (0.14)		0.01 (0.04)	
$\Delta fedRepo:highStressCdsDummy$	-0.37** (0.14)		-0.32** (0.13)		-0.06* (0.03)		-0.00 (0.02)	
$avgCds$		-0.63 (0.43)		-0.39 (0.41)		-0.24* (0.12)		0.01 (0.04)
$\Delta fedRepo:avgCds$		-0.36* (0.19)		-0.29* (0.17)		-0.07 (0.05)		-0.00 (0.02)
Observations	1720	1720	1720	1720	1720	1720	1720	1720

Note: Firm fixed effects and heteroskedasticity robust standard errors.

[B] SLR interaction

	$\Delta ReverseRepo$							
	Total Unaffiliated		Dealer		AM		Bank	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta fedRepo$	0.21*** (0.07)	0.00 (0.12)	0.14** (0.06)	-0.04 (0.11)	0.06*** (0.02)	0.04 (0.03)	0.01 (0.01)	0.01 (0.01)
$slrDistToMin$	0.01 (0.17)	0.01 (0.17)	-0.04 (0.16)	-0.04 (0.16)	0.04 (0.06)	0.04 (0.06)	0.01 (0.02)	0.01 (0.02)
$\Delta fedRepo:slrDistToMin$		0.06*** (0.02)		0.05*** (0.02)		0.01 (0.01)		-0.00 (0.00)
Observations	1720	1720	1720	1720	1720	1720	1720	1720

Note: Firm fixed effects and heteroskedasticity robust standard errors.