UNIVERSITY OF CALIFORNIA,
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Quid Pro Quo: Liquidity Insurance in Dealer-Fund Network

DISSERTATION

submitted in partial satisfaction of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

in Finance

by

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DEDICATION

To

Nova, Ying, my parents, and friends

in recognition of their love and support

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Finally, I dedicate the thesis to my family and friends. "I will be back!"

VITA

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FIELD OF STUDY

Liquidity, Mutual Funds, OTC Markets, SEC Regulations

ABSTRACT OF THE DISSERTATION

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Luming Chen

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Using a novel security-level data from SEC on US tri-party repo, this paper investigates how trading relationship impacts liquidity provision within the dealer-fund repo network. This paper documents a unique repo rate dynamic: in normal times, funds charge a premium to dealers with whom they have the strongest trading relationship; in market-wide liquidity shocks, these dealers are rewarded with lower repo rate markup and better immediacy. I exploit the 2016 Money Market Fund Reform as an exogenous liquidity shock to establish a liquidity insurance mechanism. As liquidity insurers are not easily replaceable, shown in the unexpected liquidation case of Charles Schwab Sweep Funds, costly search incentivizes dealers to engage in such stable quid pro quo relationship with money market funds.

INTRODUCTION

Repo market has been at the center of monetary policy debate since the 2008 financial crisis. During Lehman Brother's collapse, the largest repo partner in its dealer-fund network "broke the buck"- the NAV of Reserve Primary Fund fell below $1, which made prime money market funds no longer safe vehicles for corporates to park their cash. This event triggered investors' redemption of more than $300 billion within a few days from the money market (Kacperczyk and Schnabl, 2013; Schmidt, Timmermann and Wermers, 2016). Subsequent runs at money market funds (MMFs) significantly exacerbated the liquidity drought of dealers on Wall Street, who were suffering from dealer-dealer repo runs and asset fire sales at that time (Gorton and Metrick, 2012; Martin, Skeie and Thadden, 2014).

MMFs, as cash-rich investment vehicles, provide $1.8 trillion liquidity (Copeland, Duffie, Martin and McLaughlin, 2012) through the US tri-party repo market daily. In the tri-party repo market, liquidity providers (MMFs) and liquidity demanders (high credit quality dealers) use the services of Bank of New York Mellon as a custodian bank for operational efficiency, then negotiate bi-laterally regarding repo transaction terms. This cheap and stable funding source has been utilized by dealers as a liquidity windfall (Infante, 2019), as dealers can borrow money in tri-party repo market, then lend the money to clients such as hedge funds in bilateral repo market. Dealers

rehypothecate these two repos to post no collateral other than the client's collateral. The spread in repo rate and haircut of the two repos are thus windfall profits to dealers.

However, dealer-fund repo has an inherent fragility: MMFs are open end investment vehicles with low redemption fees. As a result, MMFs are susceptible to runs. A recent repo market turmoil happened in mid-Sept.2019 (Figure 1), when large corporates withdrew cash from MMFs before the tax payment deadline. Significant outflows from MMFs, along with large amount of treasury auctions that drained dealers' cash reserve, resulted in spiked overnight money market rates, with high volatility. The Federal Reserve had to immediately step in to inject more liquidity into this market to prevent a liquidity crunch that might induce new rounds of repo default and asset fire sales.

Despite its importance to dealer's daily operation and systematic stability of the funding market, dealer-fund repo market remains at best imperfectly understood, mainly due to the lack of available repo data. The opaque, decentralized nature of this over-the-counter market also complicates policy evaluation. This paper takes advantage of several novel regulatory datasets that are part of SEC's regulation efforts in improving MMFs' transparency and offers a microscopic view into MMFs' monthly holdings of repos.

I start by showing that the dealer-fund repo pairs are stable over time. Although dealers are sophisticated financial institutions, they trade most frequently with only a small subset of money market funds. I refer them as the dealer's relationship funds. Given that dealers and funds voluntarily form stable trading pairs, I analyze the effect of a significant trading relationship on repo rate markup, haircut, and other trading terms such as principal amount. Dealers and MMFs have a significant relationship when the dealer is in the top 10 largest trading partners list of a MMF in MMF's previous quarter N-SAR form, or if a dealer has repo transaction volumes in the top 1/3rd percentile with that fund in its previous month's N-MFP holdings. In normal times, MMFs charge a premium to in-network dealers with whom they have the strongest trading relationship, compared to those out-of-network dealers that uses similar collateral to borrow the same amount of money from the same MMF at the same time. I also find that MMFs command a higher haircut to in-network dealers during normal periods. In stressed market liquidity conditions, the

But why do dealers pay such a premium to their relationship funds? Does the impact of trading relationship vary over time? To answer these questions, I use the Oct.2016 SEC reform of the money market funds (MMF) as a quasi-natural experiment to show that dealers are willing to pay a premium during normal times, only because they can get preferential rates and haircuts from

their in-network funds when a liquidity shock hits the market. Therefore, the premium dealers pay to in-network funds is *de facto* an insurance premium.

The SEC MMF reform put significant stress and imposed tighter constraints on how MMFs operate. One restriction is institutional prime MMFs can no longer operate on a stable $1 NAV. It caused significant outflows from institutional Prime MMFs as investors no longer deem these funds safe investment vehicles to park their cash. As a result, many fund companies have done the product change, switching Prime MMF offerings into Government MMFs that are immune from new regulatory changes. I leverage such a differential treatment to institutional prime MMFs and use Difference-in-Difference identification to estimate the liquidity insurance premium paid by an average dealer, and the average payoff of the dealer after a liquidity shock hits the market. I highlight how relationship impacts repo rate over time: in normal times the average borrowing premium a dealer pays to in-network MMF is 8 bps, whereas in times of liquidity stress, in-network MMF compensate the dealers with a lower markup of 7 bps, compared to similar repo trades that use the same kind of collateral by out-of-network dealers. After the 2008 financial crisis, short-term interest rate has been around zero for a long time so both the insurance premium and lower markup are economically significant. The result is surprising, considering treated MMFs themselves are facing tighter liquidity constraints after the MMF reform.

In addition, I examine how dealers react to unexpected loss of an important liquidity insurer-the Charles Schwab Sweep Funds in Sept.2018.I find the in-network dealers of Charles Schwab Sweep Funds suffer significant repo rate markup when they switch to new partner funds for liquidity. This suggest that having lost their significant partner fund, dealers had to form new dealer-fund network, but the premium is even higher than having their original in-network MMF as liquidity insurer.

Finally, I use dealer's liquidity coverage ratio (LCR), dealer's trading leverage and MMF's fund flow as explanatory variables to investigate the driving forces behind the liquidity insurance offered by MMFs to their in-network dealers. I find the MMFs are indifferent to their in-network dealers' financial condition. MMF's flow does not explain away the liquidity insurance effect, but MMF's outflow events add corroborative evidence to our MMF reform identification. Before the reform, MMF charge higher markups to in-network dealers when there's an outflow event. After the reform, MMF charge lower markups to in-network dealers when there's an outflow event. I draw the conclusion that MMFs offer liquidity insurance only when there's a market-wide liquidity shock. Dealers, fully expecting MMFs' markups in normal times, still choose to pay MMFs insurance premium, because MMFs will indeed help them mitigate market-wide liquidity shocks.

Our finding is closely related to what Di Maggio, Kermani and Song (2017) find in a dealer-dealer bond trading network, that trading partners are not

easily replaceable, even when these financial institutions are highly sophisticated. The stable trading partnership, or dealer-fund bundling behavior is in line with Li (2020), that implies dealer and funds reciprocally meet dealer's long-term financing needs if funds' short-term investment goal is met. Our paper, differing from the above two closely related papers, offers a brand-new angle at dealer-fund repo network by directly connecting dealers to funds using granular data on repo transactions.

Our paper is also the first paper in the literature to document the liquidity insurance effect of stable dealer-fund partnership. The liquidity insurance I discover in our dealer-fund repo network-the US tri-party repo market, has important macroeconomic and financial stability implications. First, the dealer-fund repo network produces one of the benchmark short-term interest rate in the financial market. The federal reserve is now using Secured Overnight Financing Rate (SOFR) from the repo market to phase out the LIBOR, which was proven to be rigged by large dealers in the 2008 financial crisis. In our dealer-fund network, the premium before liquidity shock and the mitigated markup after liquidity shock, implies that SOFR is not free from biases if dealer-fund network becomes "too big to fail". Second, the liquidity insurance mechanism I discovered indicates that financial institutions are forming their own financial stability mechanism to cope with moderate liquidity shocks. And most importantly, future financial regulations aiming at improving overall market liquidity, should focus more on MMFs

liquidity transformation ability as they are important liquidity insurers to dealer's daily transactions.

Our finding contributes to the literature by reconciling the seemingly contradictory results in previous OTC trading relationship studies. On one hand, Ashcraft and Duffie (2007) find the stronger the trading relations, the higher the borrowing rate will be in the interbank offering market, implying banks are willing to pay premiums to reduce search cost. On the other hand, Afonso, Kovner and Schoar (2014) find that stronger trading relations lead to lower borrowing rate in the interbank offering market, implying that banks mutually insure each other to defend against liquidity shock. I rule out the mutual insurance case by using the tri-party repo market data instead of the inter-bank offering data, because in tri-party repo market, borrowing-lending relationship is unidirectional: MMFs are always providing liquidity, and dealers are always demanding liquidity. Therefore, by controlling for repo collateral details (as in Hu, Pan and Wang, 2019), repo transaction terms, dealer characteristics and fund characteristics, I purge out other confounding factors that might affect the repo rate and focus only on the effect of dealer-fund relationship strength on repo rates and repo haircuts.

The rest of the paper is organized as follows. Section II reviews the current literature on trading network and repo market. Section III provides institutional background on the US tri-party repo market, presents a description of the money market reform, along with SEC's efforts on

improving MMF holding transparency using new regulatory forms. Section IV discusses our data and regression model. Section V presents our empirical results. Section VI uses the unexpected liquidation of Charles Schwab Sweep Funds to illustrate why the dealer-fund network is relatively stable. And Section VII concludes.

Related Literature and Hypothesis Development

My paper builds upon the over-the-counter market friction literature showing that search cost leads to relationship formation in OTC market. Theoretically, Duffie (2012) shows that search frictions affect investor behavior and trading outcomes in OTC markets. This friction is driven by either search costs or asymmetric information (Lagos and Rocheteau, 2009). Empirically, recent studies document an important role of trading relationships in various OTC markets, including, for example, the interbank markets where banks trade unsecured claims on their excess reserves (Ashcraft and Duffie, 2007; Cocco, Gomes and Martins, 2009; Afonso, Kovner and Schoar, 2014), money market fund lending (Chernenko and Sunderam, 2014; Han and Nikolaou, 2016; Li, 2020), and dealer-intermediated fixed-income trading (Di Maggio, Kermani and Song, 2017; Schürhoff,, Hendershott, Livdan and Li, 2017; Li and Schurhoff, 2019). While previous papers have shown that relationship matters, the focus of my paper,

however, is to illustrate how trading relationship dynamically affects asset prices in determination of repo rate and negotiation of repo haircuts between MMFs and dealers.

My paper extends relationship banking literature by investigating a collateralized dealer-fund loan market that has substantial heterogeneity to the traditional bank-firm loan market (Berger and Udell, 1995), or the retail bank-depositor market (Puri and Rocholl, 2008; Iyer and Puri, 2012). Relationship banking has been proven to be a consistently profitable business model and widely used in commercial banks (Boot, 2000; Boot and Thakor, 2000). Previous papers have illustrated the reputation incentive (Boot, Greenbaum & Thakor,1993; Dinc, 2000) of the lender will make lenders to help the borrower. Other papers have illustrated information incentive involved in the relationship between borrowing firms and lending banks will cause the lender to help the borrower. For example, Bolton, Freixas, Gambacorta & Mistrulli (2016) show that relationship banks have incentives to smooth out the interest charged on firm loans in the presence of an aggregate shock. However, Li, Lu & Srinivasan (2019) shows that relationship banks do not help in mitigating borrower's distress. My paper studies a more sophisticated loan market consist of dealers and mutual funds, and I find a liquidity insurance mechanism that is not documented before.

My paper also contributes to the literature on bank's wholesale funding market. Ivashina, Scharfstein and Stein (2015) studied dollar funding of eurozone banks. More papers have investigated banks' wholesale funding sources in the context of financial regulations, for examples, Demirgüç-Kunt and Huizinga (2010) studied bank's short-term funding in the form of non-deposits; López-Espinosa, Moreno, Rubia and Valderrama (2012) found short-term wholesale funding as the most important systemic factor leading to liquidity crisis; Huang and Ratnovski (2011) showed that short-term funding sources might withdraw in response to negative signals, as monitoring banks is costly. Li (2020) focused on bank's certificate of deposit (CD) as bank's long-term funding source, and found banks enter arrangements with money market funds to meet reciprocal liquidity demands. My paper focuses on bank's short-term funding needs in US tri-party repo market. In this market, unlike in previous literature's setting, I'm able to rule out other confounding factors thus directly pin down the funding relationship between dealers and MMFs and provides a new angle about MMFs' stabilizing function in bank's wholesale funding market. Whereas relationship in Chava and Purnanandam (2011) has a crisis propagation effect, in my paper, the relationship has a crisis mitigation effect.

My paper confirms MMFs' systemic importance as liquidity insurers and contribute to literatures on MMFs and market liquidity. Schmidt, Timmermann, and Wermers (2016) studied MMFs runs during the Lehman

Brother's fail. More papers studied money market funds in a post-regulation setting (Strahan and Tanyeri. 2015; Cipriani and La Spada, 2018). My evidence supports the liquidity provision function of the mutual fund sector (Aragon, Li and Qian, 2019). Since MMFs are essentially shadow banks providing liquidity to dealers, rolling over MMFs' over-night financing will be a key priority to dealers (Irani, Iyer, Meisenzahl and Peydro, 2020).

Current literature on repos have shown that repo market is more absorbent regarding shocks than we originally presumed (Krishnamurthy, Nagel and Orlov, 2014). Han and Nikolaou (2016) studies the mutual reliance of dealer-fund pairs in lowering borrowing rate during treasury auctions. Kotidis, and Van Horen (2018) studied repo market resilience after Basel III. On the other hand, Munyan (2017) documented significant spillover effect of repo market response to capital regulations.

Based on previous literatures on search cost, I propose the first hypothesis:

Hypothesis 1: Over-the-counter search friction incentivize dealers to pay a liquidity insurance premium to their relationship money market funds (MMFs).

In case of a market wide liquidity shortage, we expect dealers can still obtain funds from their relationship funds at favorable terms, either due to fund's reputational concerns, or fund's need to park their cash to dealers of whom they have the most complete information, thus effectively smoothing out the negative shock.

Specifically, I use the Oct.2016 MMF Reform as a quasi-natural experiment to find relationship funds provide short-term financing at favorable rates and haircuts to linked dealers. I also find the trading relationships are stable over time. In case of a forced drop of relationship funds during the liquidation of Charles Schwab Money Market Sweep Funds, dealers had to bear a higher cost when searching for new partners. These findings imply that relationship significantly impact short-term rates, and relationship bundling might exacerbate the next crisis if MMFs experience fund runs.

Whether trading relationship incurs premium or discount remains unresolved in the literature. On one hand, trading counterparty might pay a premium to keep a trading relationship, because finding another stable relationship is costly, according to Duffie, et al (2005). On the other hand, trading relationship might also bring discount, since trading counterparties might want to mutually insure in preparation for the next credit events or liquidity events, as shown in Afonso, et al (2014), Han & Nikolaou (2016). Therefore, I propose our next hypothesis:

Hypothesis 2: In-network MMFs serve as liquidity insurers to help dealers lower the cost of borrowing when liquidity shock hits the market.

Previous research focus on symmetric market such as inter-bank offering market. Problem with this approach is that it's a competitive market and we have no ways to identify whether a trade's premium or discount is due to

relationship or due to competitive bidding. I directly pin down the relationship using N-SAR filing's reported list of 10 largest trading counterparties. The N-SAR filing has an entry #22: List the 10 entities acting as principals with whom Registrant did the largest amount of portfolio transactions (include all short-term obligations, and U.S. Gov't & tax-free securities) in both the secondary market & in underwritten offerings set forth in order of size based upon total value of principal transactions during the current reporting period. I use this list of trading partners for each MMF to study an asymmetric market, where MMFs are always providing liquidity, and dealers are always demanding liquidity, to avoid the endogeneity problem that relationship's effect on trading terms is determined by trading activity. It also rules out the mutual insurance argument in Afonso, et.al (2014), and service bundling commission argument in Goldstein, et al. (2009).

Institutional Background

A. Money Market Fund Reform

The U.S. tri-party repurchase agreement (tri-party repo) market is the main dealer-fund network that the dealer uses to borrow overnight funding for asset purchases. It is used by dealers every day to finance their asset purchase. The repo market has a significant weakness: when trust between trading counterparties unraveled, regardless of institution's financial health, trading counterparties disappeared instantly. Financing costs soon rocketed sky-high, followed by defaults that caused chain-reactions. Indeed, in September 2008, when after the default of its most important linked dealer--Lehman Brothers. The interaction between risk-taking incentives and exposure to runs made MMFs reform a necessity in the post-crisis regulatory environment, so SEC imposed a new regulation on prime money markets funds to be complied on Oct.2016. Under the new rules, institutional prime MMFs are required to float their NAVs, thus breaking their perceived "safe assets" status.

However, the effectiveness of the MMF reform is yet to be validated. The opaqueness of the Tri-party repo market comes with the nature that it is over the counter, and the fact that traders rely on phone calls to borrow/lend trillions of dollars per day accentuates the underlying risk in this market. Worse still, dealers use this market to borrow overnight funding, then

purchase long-term assets, while rolling over this short-term debt day-by-day. The most recent repo market turmoil of Sept.2019 is a great manifestation. In Figure 1, US short-term rate market experience an unforeseen 300% increase of secured overnight borrowing rate (SOFR). The objective of designing SOFR by the Federal Reserve is hoping that one day, it will replace the rigged LIBOR rates, and serve as a guidance to US short-term funding market. But such an expected spike of short-term rates clearly invalidates Fed's objectives. As a result, Fed had to inject liquidity facility (again) to bring down the borrowing rates. Anecdotal evidence on Wall Street suggest that the spike is caused by a holiday of Japanese banks, where a lot of US dealers obtain their repo funding from. On Sept.17th, there's no Japanese trader on their desks, so US dealers had to borrow money from their less frequent counterparties.

One lesson we learned from the crisis is that trading counterparties need stable relationships to mitigate the effect of credit events and liquidity events, especially in repo market, an over-the-counter market where most trades are completed over the phone. In such an OTC market, buyers and sellers search and meet to bargain over the terms of trades. A large fraction of transactions in the economy are negotiated and settled in OTC markets. Mortgage-backed securities, derivatives, corporate bonds, and syndicated bank loans are only a few examples of large OTC markets. compared to centralized platforms, such as exchanges or auctions.

In July of 2014, the SEC approved a new reform on MMFs. The main pillar of these rules is that from October 2016, institutional prime & muni MMFs must sell and redeem shares based on the current market-based value of the securities in their underlying portfolios. Namely, they have to move away from a stable NAV to a floating NAV. The purpose of this regulatory change is to mitigate the risk of runs. In addition, all prime & muni MMFs will have discretion to impose "gates" on redemptions or charge redemption fees of up to 2% in times of stress.

The new regulation came into effect in October 2016, and the most affected fund type is institutional prime money market funds, other types of funds are left unchanged. In this paper, I exploit this differential treatment. I do so by studying tri-party repo data from MMF regulatory filings with the SEC (form N-MFP) both before and after reform. I find that although dealers who have a strong trading relationship with MMFs on average pay a premium to sustain this relationship, in times of market liquidity shock after the new regulation is in place (Oct.2016), those dealers actually get rewarded for being a trading partner, namely, they get a discount in borrowing rate. The tri-party repos have mostly traded between MMFs fund families and dealers, so utilizing this new reform will enable us to look into the two major players' interaction in this market when there's an exogenous shock to the liquidity, while holding other factors fixed. This difference in difference design will provide a clean identification to the hypotheses I want to test.

B. N-MFP forms and N-SAR forms

The Form N-MFP is a publicly available regulatory filing that every MMF is required to submit to the SEC each month, and N-SAR is another filing that every MMF is required to submit to the SEC every 6 months. Each N-MFP filing contains information on a fund's balance sheet, share classes, security-level portfolio holdings, performance, and investor flows. Each N-SAR form includes a list of survey questions regarding trading volume and trading partners. Funds reports all of form N-MFP information submit their filings to the SEC within the first five business days of the next month. The SEC makes all N-MFP submissions and N-SAR submissions publicly available. The N-MFP was created in May 2010 along with a set of MMF reforms adopted in the immediate aftermath of the financial crisis. The first N-MFP filings were submitted in December 2010 and have continued every month since. N-SAR filings, on the other hand, have already been in place before the crisis.

N-SAR filings, also from EDGAR database, that includes the rankings of trading counterparties based on the trading volume of all asset classes The Oct.2016 compliance date of the Money Market Reform provides us with a clean identification to study MMFs' interaction with dealers in the tri-party repo market. Repurchase agreements (repos) are considered to be the largest and the most important short-term financing channel for a variety of financial institutions (Hu, et al, 2019). I analyze how trading relationships in

this market are formed and how they affect pricing and the provision of liquidity across MMFs.

One fund can have multiple share classes, that is, types of shares that differ in terms of fees, minimum investment, and other characteristics. For each of its share classes, the fund reports the net assets, the aggregate monthly redemptions and subscriptions by shareholders, and the annualized net yield for the last seven days of the month. But in N-MFP filings, I find that repo transactions are completed at the fund family level, which is not surprising, because parent fund manages the liquidity of funds distributed to each child fund. Operating liquidity on the fund family level also has the advantage of a money pool that mitigates the effect of redemption to certain share classes. Therefore, I identify 98 fund families and 31,019 repo transactions at the fund family level from 2013 to 2019 from form N-MFP. I then match the 10 largest dealers reported in N-SAR filing that trade with a given fund family, to investigate for a given repo transaction, whether trading terms will change significantly if the counterparty is in the top 10 trading partner list.

Data and Model

A. Data Construction

I download, parse, and clean information from the form N-MFP to construct our monthly panel dataset of MMFs' repo transaction with dealers. Our dataset contains repo transaction details for 162485 repos from 2010 to 2019 including repo rate, time duration (tenor), collateral detail, repo type and two trading counterparties: the MMF and the dealer. I then parse all form N-SAR of participating MMFs to get the largest 10 dealers that trade with the MMFs, reported semi-annually. A fund's N-MFP filing specifies whether the fund is a feeder or a master fund, whether it is liquidating or merging with another fund, and whether it is a prime fund, a municipal fund, an agency fund, or a treasury fund. The filing reports the fund's month-end dollar weighted average portfolio maturity, total net assets, and the annualized gross yield for the last seven days of the month. The fund also reports its fixed NAV, at which shares are redeemed and subscribed. Most importantly, form N-MFP has a month-end snapshot of the MMFs' portfolio holdings, including detailed transaction of tri-party repo between an MMF and counterparties, mainly security dealers. Form N-SAR has an entry numbered 22 that includes MMFs' total portfolio transactions with counterparties. The list has 10 entities acting as principals with whom MMF did the largest amount of portfolio transactions (include all short-term obligations, and U.S. Gov't & tax-free securities) in both the secondary market

& in underwritten offerings in order of size based upon total value of principal transactions during the semi-annual reporting period.

B. The Model

I propose the model as the following:

$$
\begin{aligned}
Y_{ijt} = c_{ij} + \eta_{it} + \mu_{jt} \\
&+ \beta_1 \times Relation_{ij} + \beta_2 \times Prime_{ijt} + \beta_3 \\
&\times AfterReform_t + \beta_4 \times Relation_{ij} \times Prime_{ijt} \\
&+ \beta_5 \times AfterReform_t \times Prime_{ijt} \\
&+ \beta_6 \times AfterReform_t \times Relation_{ij} \\
&+ \beta_7 \times Relation_{ij} \times AfterReform_t \times Prime_{ijt} \\
&+ \beta_8 \times Control_{ijt} + \varepsilon_{ijt}
\end{aligned}
$$

Y_{ijt}: *repo rate, repo haircut, repo principal.* To test whether trading partnership has premium or discount in the tri-party repo market, I use the repo rate (repo yield) as our dependent variable. I also investigate the effect of trading relationship on the trading principal and trading haircut, to see if MMFs will provide special trading terms to their trading partners, after tenor and collateral of the contract have been controlled.

$Relationship_{ij}$: *NSAR_top3, NSAR_top5, NSAR_rank, Volume_1m, Volume_3m*. I create *Relationship* as a dummy variable that equals to 1 if the dealer in a given repo transaction is in the top 3/5/10 trading partner list of

the MMF. Since the top 10 list rank the trading volume from large to small, I use the numbered ranking (10 to largest, 1 to smallest, 0 to those dealers not in the list) as *rank_high* to see if higher-up ranking in the top 10 list leads to more pronounced effect compared to the effect of just being in the top 10 list (*friend*). Other alternative definitions include *Volume1m, Volume3m.* For example, *Volume1m* equals 1, if among all the trading partners of a given fund in the last month(*1m*), a dealer ranks in the top 1/3 in terms of total repo trading volume with the fund.

$After\_Reform_t$: After Oct.2016, the new money market reform became effective. Other researches such as Cipriani and La Spada (2018) use other MMF Reform cutoff, including July.2014 and Nov.2015. But I found in N-MFP form has a self-reported tag that shows whether a prime fund is exempt from the new regulation, indicating the MMF is a retail prime MMF. The exempt tag switch only happened on Nov.2016. Thus, prime MMFs do not comply to the new regulation in the transition period (2014-2016). Instead, MMFs only comply after the new regulation came into effect.

$Prime_{ijt}$: $Prime$ equals 1 if a MMF is an institutional prime money market fund. The data is taken from CRSP Mutual Fund header information data.

$Control_{ijt}$: I control for tenor and collateral liquidity of a given repo contract, to hold fixed the risk factors that can explain the repo rate. I also

control for fund size and dealer size, to account for the fact that larger trading partners will have stronger bargaining power.

c_{ijt}: Repo-type fixed effect to control for the unobservable that is respective to each type of repos (Treasury Repo, Agency Debt Repo, Corporate Bond Repo, Equity Repo).

η_{it}: Fund family fixed effect for the unobservable that is respective to each of the 290 unique portfolios.

μ_{jt}: Time fixed effect to eliminate confounding factors over time periods.

Main Result

I first look at summary statistics of our sample, which includes 1 year before the Oct.2016 MMF reform, and 1 year after the Oct.2016 MMF reform. In Table 1, we can see that both the relationship funds and non-relationship funds increased repo rates after the Oct.2016 MMF Reform. However, the relationship funds only raise the repo rates by 45 basis points. Whereas non-relationship funds raise the repo rates by 57 basis points. We can also see that the relationship funds command a significantly lower haircut of 1.62%, whereas non-relationship funds command the same haircut. In terms of repo volume, both relationship funds and non-relationship funds offer the same amount of lending to dealers. Table 1 implies that relationship linked dealers are paying a premium before the liquidity shock hits the market, but after the liquidity shock, the premium dealers paid is effectively an insurance premium, as funds provided liquidity to the linked dealers at a more favorable condition (lower repo rate markup and lower haircut), compared to non-relationship trading partners.

[Table 1]

I then investigate whether repo transaction terms are affected by the relationship dummy over the whole sample period. Specifically, we test the effect of relationship on repo rate, repo haircut and repo principal. After controlling for fund fixed effect, time fixed effect and repo type fixed effect, relationship fund will on average charge 2 basis points higher to linked dealers over the whole sample period. In addition, fund inflow effectively increases the funding liquidity of the MMF thus reduces the repo rate. 1 day increase in the contract tenor (maturity) will increase the repo rate for 0.2 basis points, consistent with the term premium of repo contract. Also, less liquid collateral will be harder to liquidate in case of default, so MMFs will charge a higher repo rate (19 basis point more) for dealers that use illiquid types of collaterals such corporate bonds and equity, as shown in column (1) and column (2) of Table 2. The result is consistent if we use NSAR_top5 as an alternative measure of trading relationship, as shown in column (3) and column (4) of Table 2.

In column (5) and (6) of Table 2, we can see that on average, MMFs command a slightly higher haircut (0.2%) to their linked dealers. In column (7) and column (8), MMFs provide a slightly higher total lending amount to their linked dealers.

[Table 2]

Haircut is commonly used in repo transaction, as MMFs normally receive collaterals that have a larger market value than the principal value they lend to the dealers. This is to ensure that MMFs can liquidate the collateral in the event of default and get as much money back as possible. Nagel et al. (2014) find that even during the 2008 financial crisis, the haircut is quite stable around 2-3%. Our baseline in Table 2 confirms their result that across the whole sample, the difference between haircuts for relationship dealers and non-relationship dealers is small.

Figure 2 graphs the total number of repo transactions (frequency) between each matched MMF and linked dealers. Blue square means the matched MMF and linked dealer has over 1000 repo transaction in the dataset. Light green square means the corresponding MMF and dealer has almost zero repo transaction. The Y axis is the coded MMF name, and the X axis are the major dealers in this market.

For the several deep blue squares in Figure 2, the relationship MMFs are Fidelity Government Fund Family and Fidelity Prime Fund Family, and the linked dealers are Bank BNP Paribas, MUFJ, and Royal Bank of Canada. As in Hu, et al. (2019). They also find that Fidelity Fund Family is the "systematically important player" in the US Tri-party Repo market. Figure 2 also shows that the trading relationships are stable over time, with a lot of

pairs in light blue (strong trading relations), and a sparse matrix mostly consist of light green, which means the matched pairs have little to zero trading relationship.

The fact that dealers pay a premium to their relationship funds is puzzling. Given that both dealers and MMFs are sophisticated financial institutions, I expect dealers to shop for the best rate on the market to borrow money from MMFs. However, as we can see in Figure 2, even for traditional investment banks such as BNP Paribas (BNP) and Royal Bank of Canada (RBC), they only trade with a certain subset of MMFs. And their most significant trading partner is Fidelity Government Funds shown in red squares in Figure 2.

[Figure 2]

Why do dealers limit themselves to only a subset of the MMFs and pay a premium to their relationship funds? Next, I use the 2016 MMF reform as an exogenous liquidity shock to the US Tri-party Repo Market, and study whether relationship MMFs charge a higher or lower repo rate to the linked dealers, holding other factors constant.

To illustrate that the 2016 MMF reform is indeed an exogenous shock that affect prime MMFs the most, I graph the median flow difference between

prime MMFs and non-prime MMFs in Figure 3. In Figure 3, the large outflow happens around the Oct.2016 MMF reform compliance date, which supports our argument that the MMF reform is an exogenous shock to market liquidity.

[Figure 3]

Figure 4 further illustrates the differential treatment of prime MMFs vs non-prime MMFs during the 2016 MMF reform. In Figure 4, the median repo rate difference between prime MMFs and non-prime MMFs jumped significantly after the Oct.2016 MMF reform. After the reform, prime MMFs see huge outflow, and some prime MMFs even convert themselves completely to government MMFs. Therefore, the liquidity shortage forces prime MMFs to charge a higher repo rate.

[Figure 4]

Most importantly, I find Figure 5 consistent with the result in Table 1, that relationship funds do offer a discount to their linked dealers in case of a

liquidity shock. In Figure 5, the median repo rate difference between relationship repo trades and non-relationship repo trades had a huge drop around the Oct.2016 MMF reform. It shows that relationship funds, compared to non-relationship funds, offered a discount to their linked dealers.

[Figure 5]

Table 3 compares the effect of relationship both before and after the 2016 MMF reform. For repo rate, relationship's effect switched from positive to negative, consistent with the result shown in Table 1. Before the reform, relationship MMFs charge a 1.6 basis points higher repo rate to its linked dealers, whereas after the reform, relationship MMFs charge a half basis point lower repo rate to its linked dealers. For repo haircut and repo principal, relationship MMFs do not change the terms when dealing with in-network dealers vs out-of-network dealers.

[Table 3]

The result in Table 3 is surprising. Investors fled out of MMFs especially Prime MMFs. Given the fact that liquidity decreased in the US tri-party repo market after the 2016 MMF reform, it is expected that MMFs will raise the

repo rate charged to dealers. However, I find significant repo rate discount that is offered by MMFs to their relationship dealers.

To further disentangle the phenomenon, I utilize the differential treatment to prime MMFs during the 2016 MMF reform as a difference-in-difference design. Since prime MMFs are most affected in terms of liquidity, compared to government MMFs, the diff-in-diff regression will show different responses to the reform for different types of MMFs.

Table 4 shows the effect of MMF reform on prime MMFs using several different relationship variables. In Column (1)-(3) of Table 4, the coefficient of *Prime*After_Reform* has significantly positive coefficients, which is consistent with the fact that prime MMFs were hit the hardest in the MMF reform, so that on average, the prime MMFs raise their repo rate after the reform. I find the same result when I change *Relationship* definition from N-SAR dealer ranking based ones *NSAR_TOP3, NSAR_TOP5, NSAR_rank*, to N-MFP based measures *Volume1m, Volume3m*.

[Table 4]

Table 5 illustrates the effect of relationship on repo rate when there is an exogenous liquidity shock. In Column (1)-(4) of Table 5, the effect of

*PrimeMMF*After-Reform*Relationship* is negative. The result is consistent with the summary statistics in Table 1: when the MMF reform hit the market and significantly drained the liquidity of prime MMFs, MMFs surprisingly offers a lower repo rate markup (a discount) to their relationship dealers. I then use alternative measures of *Relationship* including *Volume_1m* and *Volume_3m* and find consistent result in Table 6.

[Table 5-6]

Table 7 investigates the effect of *Relationship* on repo haircut. I find that relationship funds also offer a significantly lower repo haircut to their linked dealers in case of a market-wide liquidity shock. Table 8 shows that the lending amount by relationship funds does not significantly differ from non-relationship funds.

[Table 7-8]

I then show the diff-in-diff regression result intuitively in Figure 6, Figure 7, and Figure 8. I graph the predictive margins of the interaction term

*PrimeMMF*After-Reform*Relationship*, with *After-Reform* as *After* in the graphs. Figure 6 is using *NSAR-TOP3, NSAR-TOP5, NSAR-TOP10* as *Relationship*, Figure 7 is using *Volume1m, Volume3m* as *Relationship*. *After* equals 0 for the 1 year before the MMF reform. *After* equals 1 for the 1 year after the MMF reform. Figure 6-7 intuitively shows that relationship funds act as liquidity insurers and keep the repo rate markup stable after the MMF reform, as the yellow line is relatively flat. But non-relationship funds significantly raised the repo rate markup after the MMF reform, causing the green line to shoot up higher than the yellow line. As for control groups (non-Prime funds, not affected by the MMF reform), the red and blue line stays relatively flat. This also means that relationship Prime MMFs, even when hit by a liquidity shock, will absorb the shock so that linked dealers can enjoy stable short-term rate environment, like linked dealers of control group funds.

[Figure 6-7]

Figure 8 graphs the effect of relationship on repo haircuts, and I find similar result: even the funding liquidity worsened after the reform, relationship funds surprisingly offered favorable trading terms including

lower repo rate, lower repo haircut, and same amount of lending to their linked dealers.

[Figure 8]

To summarize, during normal times, a dealer will have to pay an average premium of 2 basis points being in the top linked-dealer list. However, in case a liquidity shock hits the market, relationship funds will return the favor with a significantly lower markup (around 7 bps) and a lower haircut to the linked dealers, without reducing the total lending amount, thus effectively serving the role of liquidity insurer.

The benefit of this quid-pro-quo relationship is obvious: dealers can purchase an insurance that facilitates their daily roll-over of short-term debt, that is mostly leveraged and invested in long-term securities such as corporate bonds. And the consequence is that over time, MMFs and dealers build stable relationships that is shown in Figure 2.

Our result, unlike previous research in the literature, captures borrowing rate premium and discount under the same setting. The surprising result that affected MMFs even lend more to linked dealers, at favorable terms, can be explained by MMFs' needs to place investors' cash in a predictable and smooth way when there is a market wide liquidity shock. This result cannot

be explained by the commission bundling (Goldstein, et al, 2009) or mutual insurance (Afonso, et al, 2014) because the dealer is not providing service to the MMF in the repo transaction, and the asymmetric nature of the tri-party repo markets means there is no mutual insurance in this market. In this case, the relationship premium can be explained by the search cost as in Duffie (2005), and the surprising relationship discount can only be explained by MMFs reliance on their trading relationship with dealers. Whether MMFs are rewarding relationships or smoothing their investment on dealers need further tests, however I can conclude that although maintaining a trading relationship is on average costly, in times of liquidity events and credit events, the relationship really pays off.

Robustness Checks: Alternative Explanations

In the main result I formulate the relationship measure using both N-SAR dealer rankings, and repo trading volume rankings calculated from N-MFP repo holdings. Previous literature such as Han and Nikolaou (2016) construct dependence measures based on repo transaction volume, so I also test the result with the trading volume dependence measure. Dependence, or effectively bargaining power of each counterparty, is defined as the total repo trade volume in each Dealer-Fund pair, divided by the total repo transaction volume of a given dealer (fund has bargaining power) or a given fund (dealer has bargaining power).

In Table 9, the *Relationship* dummy equals 1 if the dependence measure is in the top 1/3rd rank based on repo volume of the past 1-month and past 3-month period. I find that dealers who are more dependent on relationship MMFs, will pay a premium of around 1 bps.

[Table 9]

Intuitively, we should find discount, if MMFs are dependent on dealers. As shown in Table 10. The result in Table 9 and Table 10 is still consistent with my finding that relationship funds will offer liquidity insurance to linked

dealers, as the magnitudes of the interaction term is much smaller than what I find in the main result. Therefore, bargaining power cannot fully explain the liquidity insurance effect.

[Table 10]

Although the main result controls for dealer fixed effects, fund fixed effects and repo type fixed effects, there are still time variable characteristics of dealers and funds that might drive our result. To further rule out these confounding factors, I first add dealer's liquidity coverage ratio (LCR) and trading leverage as additional controls, and the result is still consistent with main result. The coefficient of *PrimeMMF*After-Reform*Relationship* is still significantly negative, as shown in Table 11.

[Table 11]

I then investigate if the funding liquidity MMFs is driving the main result. In Table 2, the baseline regression already shows that fund inflow (%) will

significantly lower the repo rate. Therefore, Table 12 focuses on fund outflow events (15% outflow/10% outflow/5% outflow) to see how relationship funds treat their linked dealers in response to unexpected liquidity shocks.

In any of the outflow events (15%/10%/5%), relationship funds all offered lower repo rate to their linked dealers after the Oct.2016 reform. This shows that the main result is robust, even if the market liquidity shortage is driven by some funds' liquidation at 15%, or all funds having moderate outflows at 5%.

[Table 12]

Therefore, the main result that relationship MMFs offering liquidity insurance to their linked dealers is not explained by the bargaining power of MMFs/Dealers, dealer's credit worthiness indicators including liquidity coverage ratios and trading leverage. The main result is also robust in cases where large outflow happens in some funds, moderate outflow happens in more funds, or both.

Search Cost: the Case of Schwab Sweep Fund Liquidation

I have shown liquidity insurance hypothesis hold. But as Li, Lu & Srinivasan (2019) have shown, big borrowing firms will have alternative source of funding. Therefore, in times of borrower stress, lender does not provide liquidity insurance. Therefore, banks are not helping firms in times of stress.

The borrowers in our framework are all large dealers who have all sorts of alternative source of funding. For our story to hold, search cost must be high enough to make sure the dealers don't switch randomly among all other funds. To estimate the search cost, I introduce another quasi-natural experiment that involves Charles Schwab's unexpected announcement that they are switching their Sweep Funds to bank deposit products, reducing the yield provided to investors from 2% in April.2018 to 0.65% from bank deposits. This sharp drop in yield caused huge outflow to the 3 funds that are affected.

[Table 13]

Table 13 shows the 3 now liquidated funds in the Schwab Sweep family (ticker: SWMXX, SWQXX, SWSXX), and their respective linked dealers. We can

see that over time in our sample, and across funds, the linked dealers to Schwab Sweep Fund Family is almost the same, confirming our finding that trading partnerships are stable over time.

[Table 14]

In Table 14, we can see that the most affected dealers by Schwab Sweep's sudden liquidation, in terms of total % of repo trades placed with Schwab Sweep Funds.

[Table 15]

Table 15 use this event as a quasi-natural experiment and estimated the search cost for the 4 most affected dealers, after the Schwab Sweep liquidation. *Affected_Dealers* equals 1 if the linked dealer is any of the 4: Credit Suisse, Barclays, Royal Bank of Canada and Wells Fargo. After the Schwab liquidation (*Post_Liquidation* equals 1), the 4 affected dealers are most affected, with a repo rate markup of ~3 basis points, compared to the control group dealers. In other words, even though the whole tri-party repo

market has a liquidity shock (Schwab Sweep exit the market), other non-linked dealers are not as severely impacted as the 4 linked dealers. It's consistent with our hypothesis that search cost and insurance needs incentivize dealers to form stable relationship with the funds. The result can be shown intuitively in Figure 9.

[Figure 9]

Figure 9 shows that after the fund liquidation, dealers need to find new trading partners. They had to bear higher cost due to the OTC nature of this market. But the fact that the cost is even higher than before the liquidation illustrates the key incentive that is driving the main result: dealers are better off maintaining this trading relationship because MMFs' liquidity insurance in case of liquidity shocks indeed lowers the overall financing cost of dealers.

Conclusion

This paper uses a novel security-level data from SEC on US tri-party repos and investigates how trading relationship impacts liquidity provision within the dealer-fund repo network. This paper documents a unique repo rate dynamic: in normal times, funds charge a premium to dealers with whom they have the strongest trading relationship; in market-wide liquidity shocks, these dealers are rewarded with lower repo rate markup and better immediacy. My identification exploits the 2016 Money Market Fund Reform as an exogenous liquidity shock to establish this liquidity insurance mechanism. As liquidity insurers are not easily replaceable, shown in the unexpected liquidation case of Charles Schwab Sweep Funds, costly search incentivizes dealers to engage in such stable quid pro quo relationship with money market funds.

In this paper I construct a novel dataset matching dealer-fund pairs in N-MFP forms and dealer-fund pairs in N-SAR forms to yield a complete trading network between Money Market Funds (MMFs) and dealers. I identify each fund-dealer pair and investigate how their relationship change over time can affect repo rates and repo haircuts in US tri-party repo market. I test the prediction that over-the-counter search friction incentivize dealers to pay a liquidity insurance premium to their relationship money market funds (MMFs). In case of a market wide liquidity shortage, dealers can still obtain

funds from their relationship funds at favorable terms, thus effectively smoothing out the negative shock. Using the Oct.2016 MMF Reform, I confirm my hypothesis that dealers are paying an insurance premium of around 2bps before the MMF reform. But relationship MMFs provide favorable trading terms to linked dealers after the reform. Therefore, Prime MMFs are playing the role of liquidity insurers. I also find the trading relationships are stable over time. In the liquidation case of Charles Schwab Money Market Sweep Funds, 4 most affected dealers had to bear 3bps more markup than control group dealers, because they need to search for new relationship funds.

These findings imply relationship bundling might exacerbate the next crisis if MMFs experience fund runs. In our sample, the Fidelity Prime Funds and Fidelity Government Funds significantly out-lend other funds, both in repo trade frequency and repo trade volume. If Fidelity experience extreme outflow, then its most connected dealers will have difficulty borrowing the money to roll-over their short-term debt, which will again lead to the repo market turmoil as we have seen in 2008. In addition, dealers will fire sale their long-term assets if they have difficulty rolling over their short-term financings such as the tri-party repo. As a result, dealers will keep buying this liquidity insurance to smooth out unexpected liquidity shocks.

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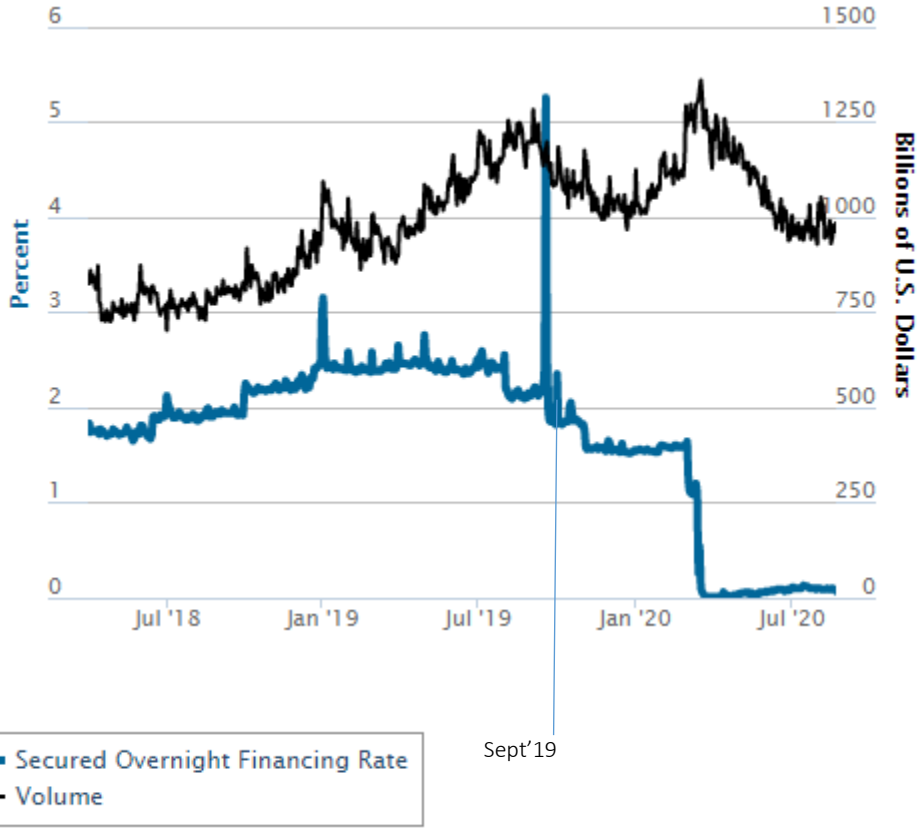
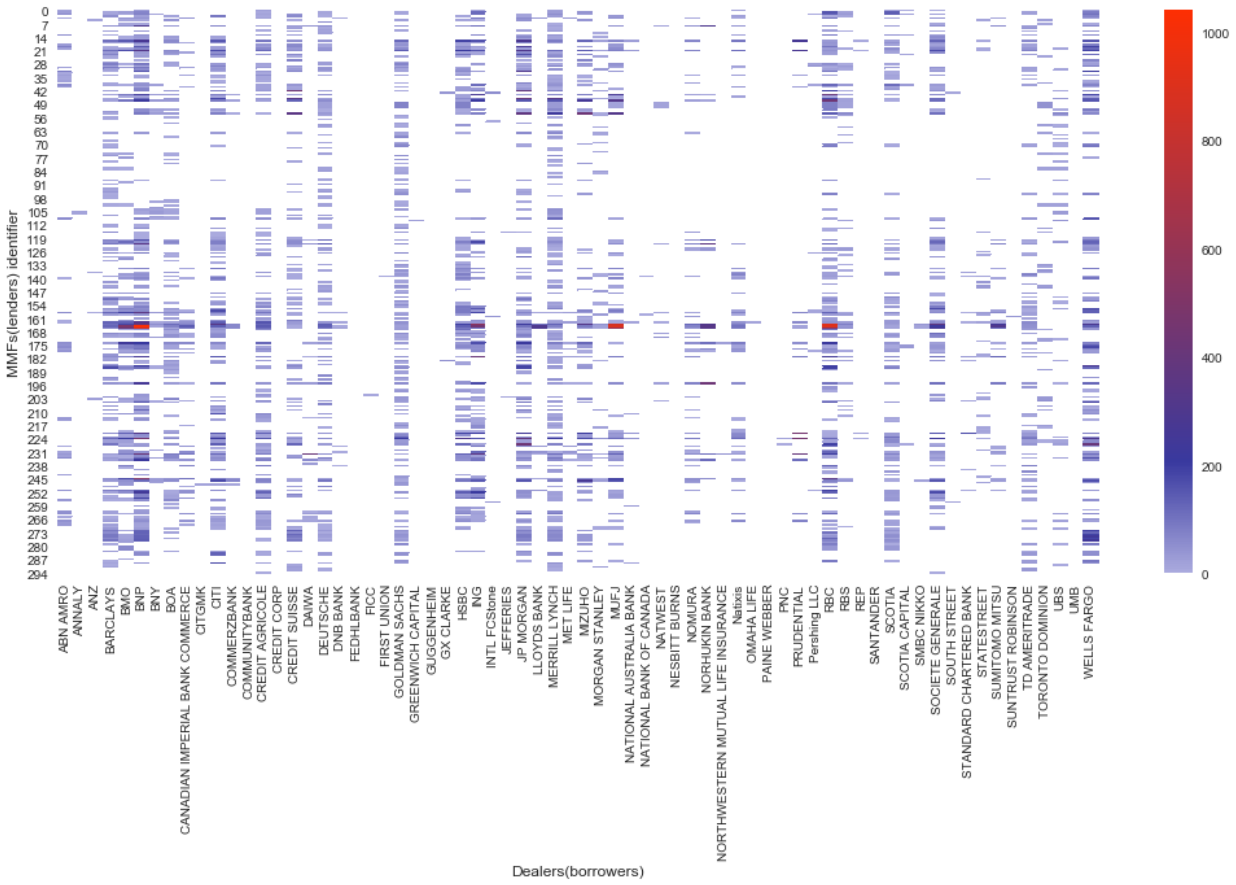
Figure 1. Repo turmoil in Sept.2019



Source: Federal Reserve SOFR website

Figure 2. Summary of Repo Trades in US Tri-party Repo Market



Source: Author's calculation based on N-MFP data

Figure 3. Median flow difference between prime MMFs and non-prime MMFs

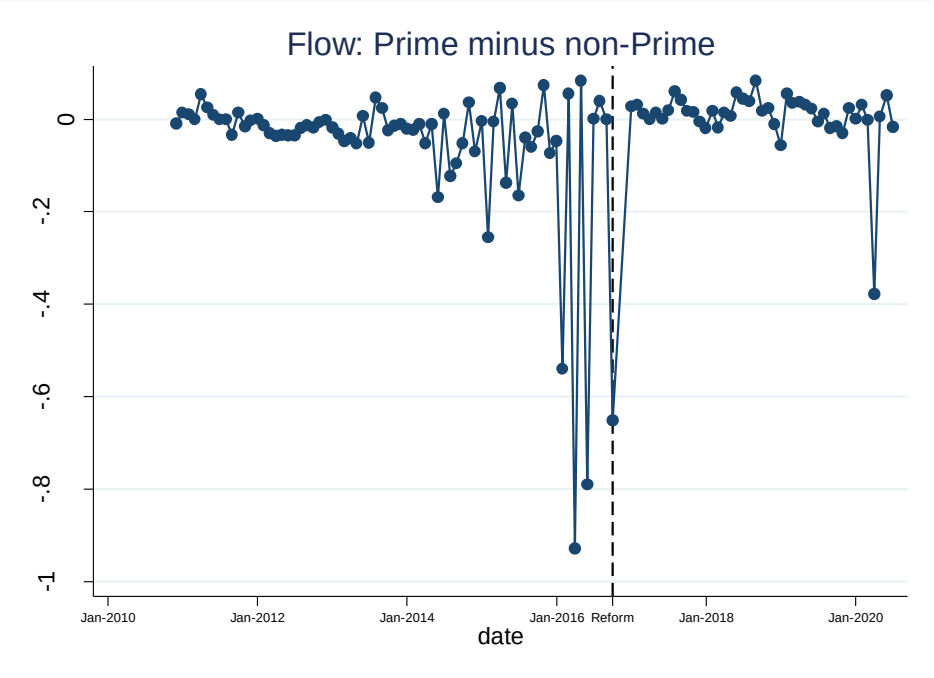


Figure 4. Median repo rate difference between prime MMFs and non-prime MMFs

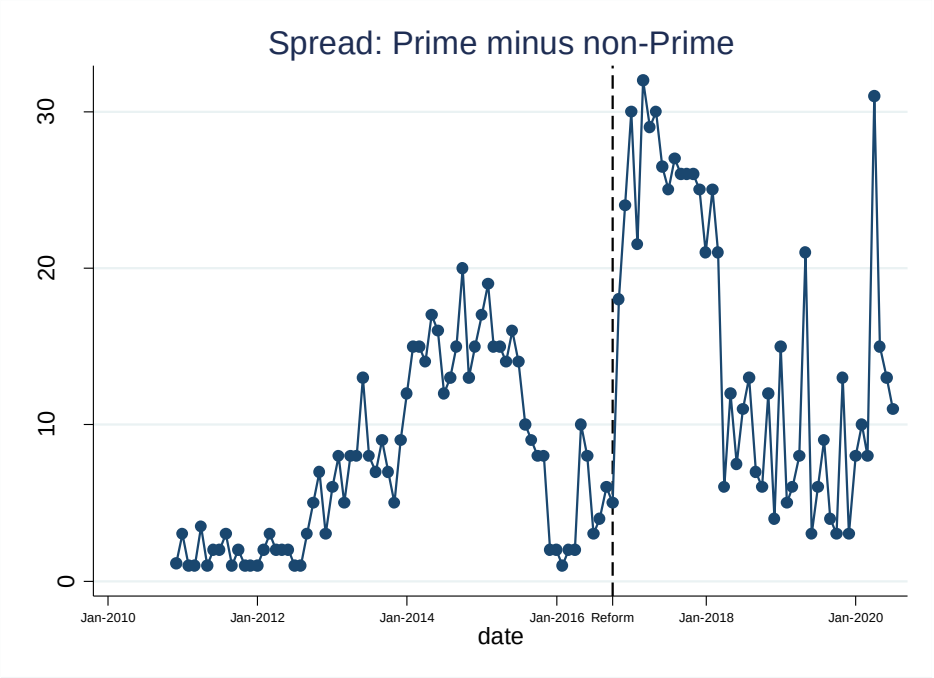


Figure 5. Median repo rate difference between relationship repo trades and non-relationship repo trades.

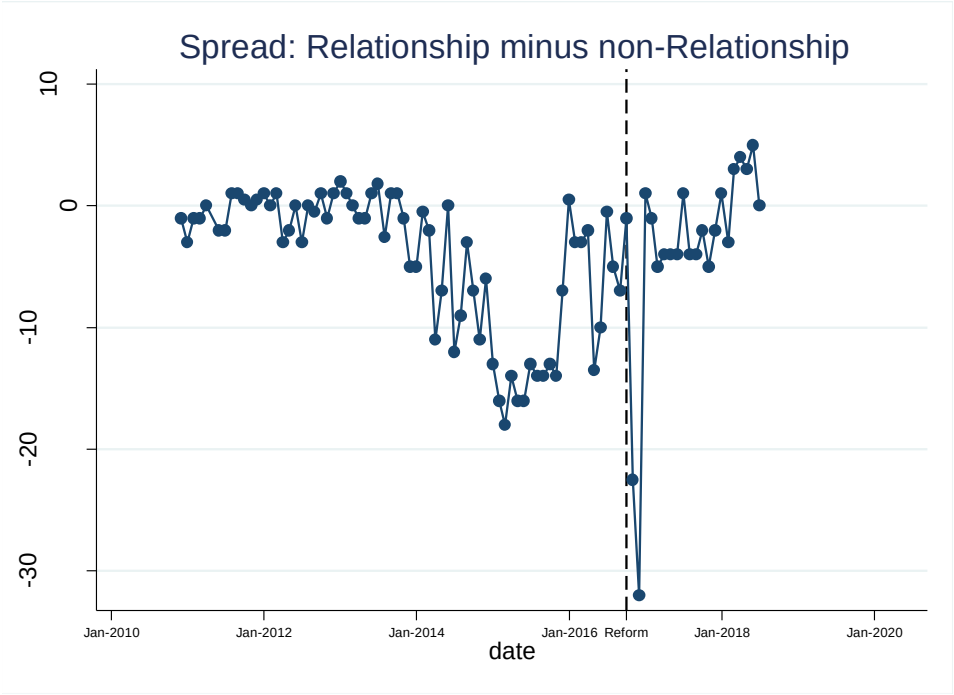
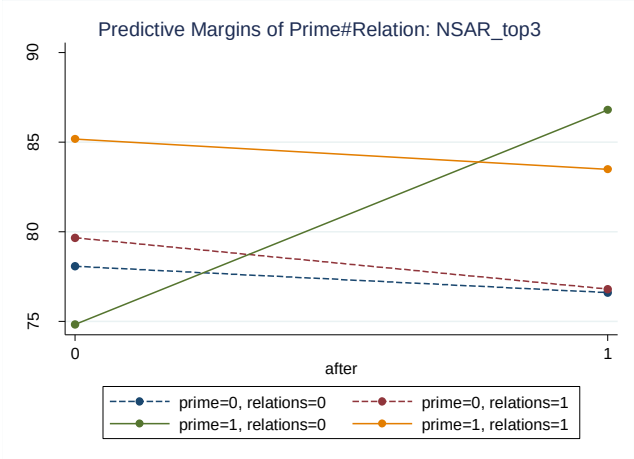
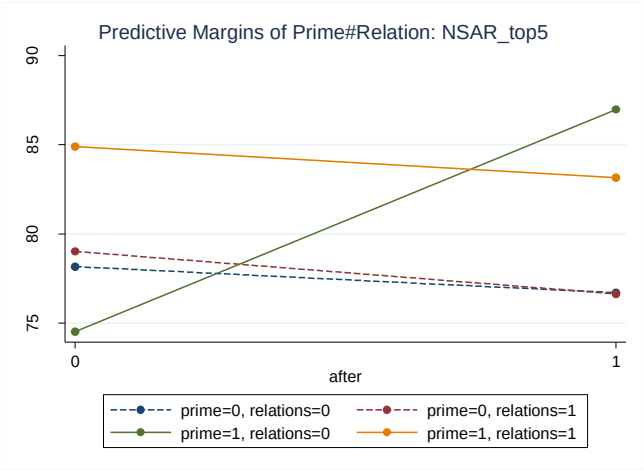


Figure 6. Predictive Margin of the Interaction Term: NSAR-based Relationship

Relation=1 when the dealer is among the top 3/5/10 largest trading partners in the Money Market Fund's NSAR filing.(NSAR_Top3/ NSAR_Top5/ NSAR_Top10)





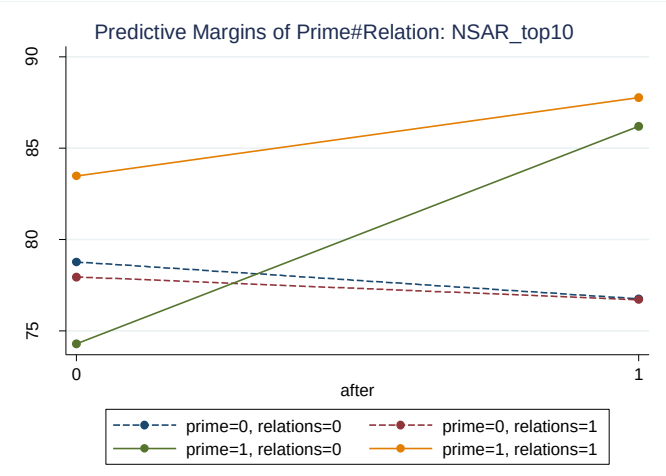
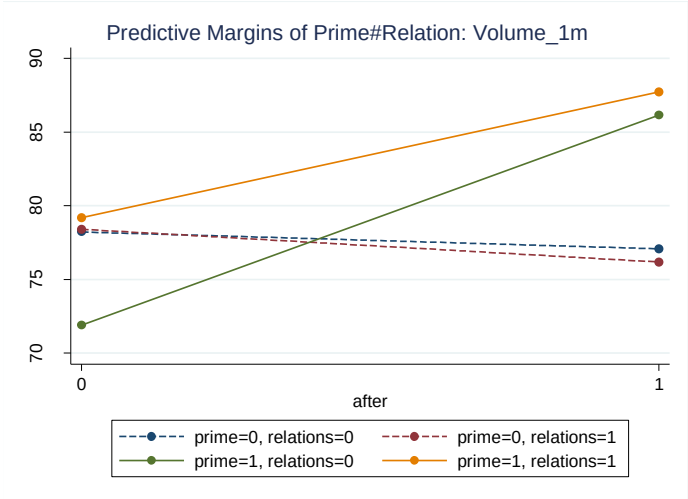


Figure 7. Predictive Margin of the Interaction Term: NMFP-based ranking, repo rate

Relationship is a dummy variable that equals 1 if a dealer has repo trading volume in the top 1/3rd percentile with a MMF in the past 1 month (Volume_1m), or past 3 months(Volume_3m)



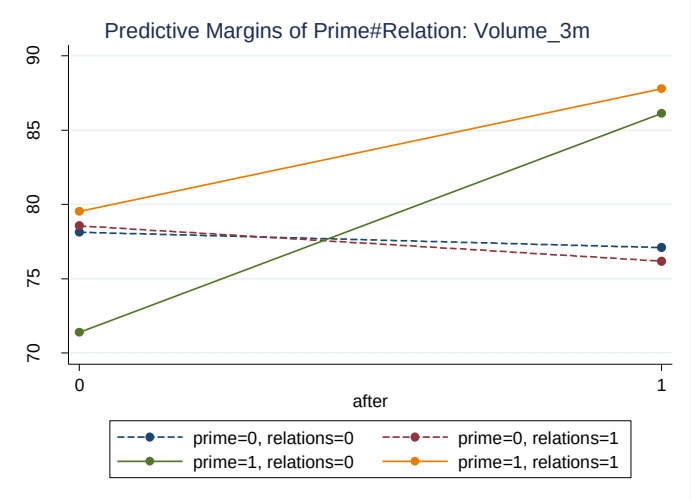
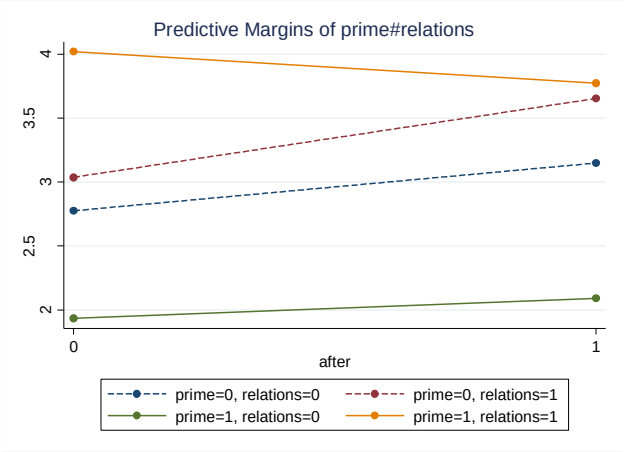
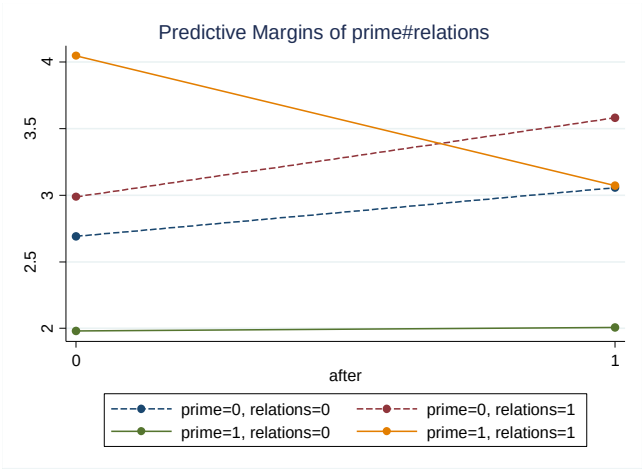


Figure 8. Predictive Margin of the Interaction Term: NSAR-based ranking, repo haircut

Relation=1 when the dealer is among the top 3 largest repo trading partners in the N-SAR dataset.





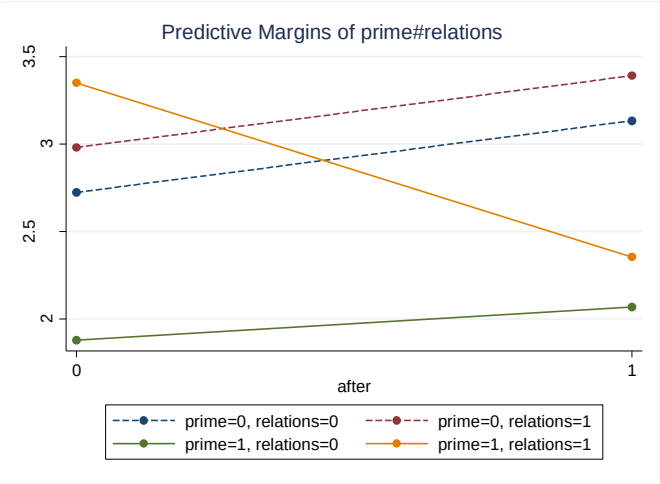


Figure 9. Charles Schwab Sweep Funds liquidation shock

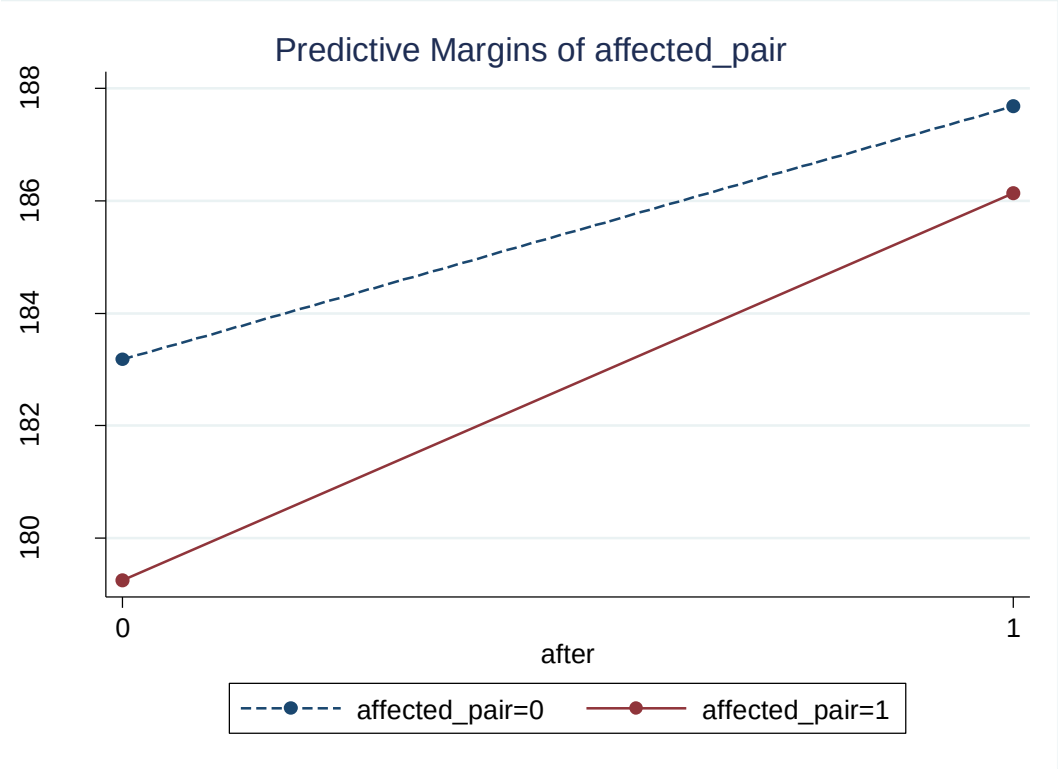


Table 1. Summary Statistics

Table 1 shows the summary statistics of repo trade terms, fund characteristics, dealer characteristics, and general market liquidity condition. RepoRate is the repo rate reported on a given repo transaction. Principal is the total money borrowed by the dealer/lent by the fund on a given repo transaction. Tenor is the maturity on a repo transaction. Fed Rate is the Federal Funds Rate, which is the benchmarking short-term interest rates. Fund Size is the total amount lent out by a fund in a given month. Dealer Size is the total amount borrowed by a dealer in a given month. Sample Period: Oct.2015-Oct.2017 (one year before the MMF reform and one year after the MMF reform).

	Mean				
Relationship=1	Pre-Reform	Post-Reform	Diff.	Std. Error	Obs.
RepoRate	**49.50**	**94.95**	**45.46*****	0.95	10439
Haircut	**4.97**	**3.35**	**-1.62*****	0.10	10439
Principal	**4.52**	**4.67**	**0.15*****	0.05	10439
Illiquid	0.24	0.10	-0.14***	0.01	10439
Tenor	13.13	7.24	-5.89***	0.54	10439
Fed Rate	31.43	95.14	63.71***	0.62	10439
Fund Size	1.72	7.46	5.74***	0.23	10439
Dealer Size	2.25	16.05	13.80***	0.36	10439
Fund Flow	0.00	0.01	0.01	0.01	10439

	Mean				
Relationship=0	Pre-Reform	Post-Reform	Diff.	Std. Error	Obs.
RepoRate	**39.29**	**97.18**	**57.89*****	0.75	14155
Haircut	**3.57**	**3.42**	**-0.15****	0.07	14155
Principal	**3.84**	**4.00**	**0.16*****	0.04	14155
Illiquid	0.13	0.11	-0.01	0.01	14155
Tenor	6.71	6.41	-0.30	0.39	14155
Fed Rate	32.73	94.09	61.36***	0.46	14155
Fund Size	1.22	5.31	4.09***	0.14	14155
Dealer Size	1.70	6.99	5.29***	0.14	14155
Fund Flow	-0.01	0.01	0.03***	0.00	14155

Table 2. Baseline-repo rate, repo haircut, repo principal

Table 2 shows the impact of relationship (NSAR_top3, NSAR_top5) on repo rate, repo haircut and repo principal.

Relationship is a dummy variable that equals 1 if a dealer is the top3/5 largest trading partner of a MMF in its NSAR form. Standard errors are clustered on the fund level.

	Repo_Rate: top3 Relation		Repo_Rate: top5 Relation		Haircut		Principal	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	NSAR_top3	NSAR_top3	NSAR_top5	NSAR_top5	NSAR_top3	NSAR_top5	NSAR_top3	NSAR_top5
Relationship	**2.22*** **	**2.11*** **	**1.64*** **	**1.49*** **	**0.17*** **	**0.24*** **	**0.18*** **	**0.20*** **
	(0.53)	**(0.53)**	**(0.43)**	**(0.43)**	**(0.09)**	**(0.07)**	**(0.06)**	**(0.05)**
Fund_flow		-2.16***		-2.17***				
		(0.76)		(0.75)				
Principal	0.91***	0.92***	0.90***	0.92***	0.08***	0.07***		
	(0.26)	(0.26)	(0.26)	(0.27)	(0.03)	(0.03)		
Illiquid	19.46***	19.33***	19.53***	19.40***	0.46*	0.47*	-0.30**	-0.28**
	(2.79)	(2.82)	(2.80)	(2.83)	(0.25)	(0.25)	(0.12)	(0.12)
Tenor	0.19***	0.19***	0.19***	0.19***	0.01	0.01	0.00***	0.00***
	(0.05)	(0.05)	(0.05)	(0.05)	(0.01)	(0.01)	(0.00)	(0.00)
Fed_rate	1.09***	1.08***	1.09***	1.08***	0.01	0.01	-0.02**	-0.02**
	(0.08)	(0.08)	(0.08)	(0.08)	(0.01)	(0.01)	(0.01)	(0.01)
Constant	9.79***	9.95***	9.53***	9.71***	4.56***	4.54***	3.40***	3.37***
	(2.32)	(2.33)	(2.38)	(2.38)	(0.27)	(0.27)	(0.22)	(0.21)
Observations	18,951	18,626	18,951	18,626	18,947	18,947	18,951	18,951
# of Portfolios	116	113	116	113	116	116	116	116
Adjusted R-sq	0.75	0.75	0.75	0.75	0.55	0.55	0.16	0.16
RepoType FE	YES	YES	YES	YES	YES	YES	YES	YES
Dealer FE	YES	YES	YES	YES	YES	YES	YES	YES
Fund FE	YES	YES	YES	YES	YES	YES	YES	YES

Table 3. Before vs After Reform: repo rate, haircut, principal

Table 3 shows the impact of relationship (NSAR_top3, NSAR_top5) on repo rate, repo haircut and repo principal, both before and after the MMF reform

Relationship is a dummy variable that equals 1 if a dealer is the top3 largest trading partner of a MMF in its NSAR form. Standard errors are clustered on the fund level.

	Repo rate		Repo haircut		Repo principal	
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	before	after	before	after	before	after
Relationship	**1.64*** **	**-0.62***	**0.24*** **	**0.40*** **	**0.20*** **	**-0.02**
	(0.43)	**(0.34)**	**(0.07)**	**(0.10)**	**(0.05)**	**(0.04)**
Principal	0.90***	0.63**	0.07***	0.01		
	(0.26)	(0.28)	(0.03)	(0.01)		
Illiquid	19.53***	18.00***	0.47*	0.33*	-0.28**	0.07
	(2.80)	(4.51)	(0.25)	(0.18)	(0.12)	(0.08)
Tenor	0.19***	0.14***	0.01	0.01**	0.00***	-0.00
	(0.05)	(0.05)	(0.01)	(0.00)	(0.00)	(0.00)
Fed_rate	1.09***	1.16***	0.01	-0.00	-0.02**	0.00
	(0.08)	(0.01)	(0.01)	(0.00)	(0.01)	(0.00)
Constant	9.53***	15.91***	4.54***	7.03***	3.37***	4.04***
	(2.38)	(3.86)	(0.27)	(0.81)	(0.21)	(0.23)
Observations	18,951	25,891	18,947	25,891	18,951	25,891
# of Portfolios	116	171	116	171	116	171
Adjusted R-sq	0.75	0.93	0.55	0.43	0.16	0.09
RepoType FE	YES	YES	YES	YES	YES	YES
Dealer FE	YES	YES	YES	YES	YES	YES
Fund FE	YES	YES	YES	YES	YES	YES

Clustered standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.

Table 4. MMF Reform Impact to Prime Funds

Table 4 illustrates how MMF reform impacted repo trade terms of prime money market funds. Relationship is a dummy variable that equals 1 if a dealer is the top3/5 largest trading partner of a MMF in its NSAR form. NSAR_rank means the Relationship variable is a discrete rank from 1 to 10. Standard errors are clustered on the fund level.

	repo rate			haircut		principal	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	NSAR_top3	NSAR_top5	NSAR_rank	NSAR_top3	NSAR_top5	NSAR_top5	NSAR_top1
Relationship	**1.58*** **	**1.05** **	**0.15** **	**0.45*** **	**0.55*** **	**0.15*** **	**0.11*** **
	(0.44)	**(0.43)**	**(0.06)**	**(0.12)**	**(0.11)**	**(0.04)**	**(0.03)**
Prime	-0.78	-0.65	-0.67	-0.82***	-0.77**	-0.51	-0.50
	(2.45)	(2.47)	(2.47)	(0.30)	(0.30)	(0.37)	(0.37)
After_Reform	-1.52**	-1.50**	-1.54**	0.38***	0.38***	-0.13	-0.13
	(0.74)	(0.75)	(0.75)	(0.12)	(0.12)	(0.11)	(0.11)
Prime*After_Reform	**10.82*** **	**10.68*** **	**10.71*** **	**-0.45*** **	**-0.50*** **	**-1.32*** **	**-1.33*** **
	(1.52)	**(1.54)**	**(1.54)**	**(0.15)**	**(0.16)**	**(0.21)**	**(0.21)**
Principal	0.60***	0.60***	0.60***	0.02	0.01		
	(0.15)	(0.15)	(0.15)	(0.02)	(0.02)		
Illiquid	15.32***	15.36***	15.36***	-0.02	0.00	0.07	0.07
	(3.81)	(3.81)	(3.81)	(0.25)	(0.25)	(0.06)	(0.06)
Tenor	0.21***	0.21***	0.21***	0.01***	0.01***	-0.00	-0.00
	(0.07)	(0.07)	(0.07)	(0.01)	(0.01)	(0.00)	(0.00)
Fed_Rate	0.95***	0.95***	0.95***	0.00	-0.00	-0.00***	-0.00***
	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	24.41***	24.38***	24.26***	6.24***	6.25***	4.28***	4.24***
	(4.12)	(4.12)	(4.13)	(0.63)	(0.62)	(0.20)	(0.20)
Observations	29,323	29,323	29,323	29,319	29,319	29,323	29,323
# of Portfolios	199	199	199	199	199	199	199
Adjusted R-sq	0.85	0.85	0.85	0.51	0.51	0.14	0.14
RepoType FE	YES	YES	YES	YES	YES	YES	YES
Dealer FE	YES	YES	YES	YES	YES	YES	YES
Fund FE	YES	YES	YES	YES	YES	YES	YES

Table 5. Difference-in-Difference: MMF reform on repo rate, N-SAR relationship ranking

Table 5 illustrates how MMF reform impacted repo rate for relationship trades vs non-relationship trades. Relationship is a dummy variable that equals 1 if a dealer is the top3/5 largest trading partner of an MMF in its NSAR form. NSAR_rank means the Relationship variable is a discrete rank from 1 to 10. Standard errors are clustered on the fund level. Prime is a dummy variable that equals 1 if the fund is a prime MMF.

VARIABLES	(1) NSAR_top3	(2) NSAR_top5	(3) NSAR_top10	(4) NSAR_rank
Prime	-1.24	-1.52	-1.80	-1.42
	(2.63)	(2.54)	(2.76)	(2.73)
Relationship	2.33***	1.85**	0.40	0.18**
	(0.81)	(0.73)	(0.64)	(0.09)
Prime*Relationship	4.22**	4.71***	5.69***	0.77***
	(1.64)	(1.64)	(1.49)	(0.21)
After_Reform	-1.33	-1.23	-1.51*	-1.30
	(0.83)	(0.87)	(0.88)	(0.90)
Prime*After_Reform	11.44***	11.76***	11.43***	11.49***
	(1.66)	(1.47)	(1.61)	(1.66)
Relationship*After_Reform	-1.13	-1.09	0.06	-0.08
	(0.83)	(0.71)	(0.63)	(0.09)
Relationship*Prime*After_Reform	**-7.33*** **	**-8.19*** **	**-4.52*** **	**-0.73*** **
	(2.27)	**(2.74)**	**(1.56)**	**(0.22)**
principal	0.58***	0.57***	0.59***	0.58***
	(0.15)	(0.15)	(0.15)	(0.15)
illiq	15.28***	15.33***	15.28***	15.30***
	(3.79)	(3.81)	(3.80)	(3.79)
tenor1	0.21***	0.21***	0.21***	0.21***
	(0.07)	(0.07)	(0.07)	(0.07)
fed_rate	0.95***	0.95***	0.95***	0.95***
	(0.01)	(0.01)	(0.01)	(0.01)
Constant	24.44***	24.34***	24.19***	24.23***
	(4.10)	(4.10)	(4.14)	(4.10)
Observations	29,323	29,323	29,323	29,323
# of Portfolios	199	199	199	199
Adjusted R-sq	0.85	0.85	0.85	0.85
RepoType FE	YES	YES	YES	YES
Dealer FE	YES	YES	YES	YES
Fund FE	YES	YES	YES	YES

Table 6. Difference-in-Difference: MMF reform on repo rate, N-MFP relationship ranking

Table 6 illustrates how MMF reform impacted repo rate for relationship trades vs non-relationship trades. Relationship is a dummy variable that equals 1 if a dealer has repo trading volume in the top 1/3rd percentile with a MMF in the past 1 month (Volume_1m), or past 3 months(Volume_3m). Standard errors are clustered on the fund level. Prime is a dummy variable that equals 1 if the fund is a prime MMF.

VARIABLES	(1) Volume_1m	(2) Volume_3m
Prime	-4.48*	-4.43
	(2.71)	(2.73)
Relationship	0.96	1.05
	(0.74)	(0.77)
Prime*Relationship	5.65***	6.44***
	(1.11)	(1.15)
After_Reform	-1.09	-1.09
	(0.87)	(0.83)
Prime*After_Reform	14.21***	14.03***
	(1.86)	(1.81)
Relationship*After_Reform	-0.87	-0.88
	(0.70)	(0.71)
Relationship*Prime*After_Reform	**-4.56*** **	**-5.16*** **
	(1.30)	**(1.47)**
principal	0.55***	0.56***
	(0.14)	(0.15)
illiq	15.30***	15.27***
	(3.79)	(3.78)
tenor1	0.21***	0.21***
	(0.07)	(0.07)
fed_rate	0.94***	0.95***
	(0.01)	(0.01)
Constant	24.52***	24.26***
	(4.15)	(4.07)
Observations	29,323	29,323
# of Portfolios	199	199
Adjusted R-sq	0.85	0.85
RepoType FE	YES	YES
Dealer FE	YES	YES
Fund FE	YES	YES

Table 7. Difference-in-Difference: MMF reform on repo haircut, N-SAR relationship ranking

Table 7 illustrates how MMF reform impacted repo haircut for relationship trades vs non-relationship trades. Relationship is a dummy variable that equals 1 if a dealer is the top3/5/10 largest trading partner of an MMF in its NSAR form. Standard errors are clustered on the fund level. Prime is a dummy variable that equals 1 if the fund is a prime MMF

	(1)	(2)	(3)
VARIABLES	NSAR_top3	NSAR_top5	NSAR_top10
Prime	-0.94***	-0.85***	-0.97***
	(0.28)	(0.28)	(0.29)
Relationship	0.24*	0.28***	0.27**
	(0.13)	(0.08)	(0.11)
Prime*Relationship	1.74***	1.70***	1.10***
	(0.32)	(0.26)	(0.27)
After_Reform	0.32***	0.31***	0.34***
	(0.12)	(0.09)	(0.11)
Prime*After_Reform	-0.30*	-0.36**	-0.30
	(0.17)	(0.15)	(0.20)
Relationship*After_Reform	0.23**	0.34**	0.08
	(0.11)	(0.16)	(0.11)
Relationship*Prime*After_Reform	**-0.60**	**-1.28*** **	**-1.00*** **
	(0.53)	**(0.38)**	**(0.33)**
principal	0.02	0.02	0.02
	(0.02)	(0.02)	(0.02)
illiq	-0.03	-0.02	-0.01
	(0.25)	(0.24)	(0.24)
tenor1	0.01***	0.01***	0.01***
	(0.01)	(0.01)	(0.01)
Constant	6.23***	6.30***	6.11***
	(0.62)	(0.61)	(0.62)
Observations	29,319	29,319	29,319
# of Portfolios	199	199	199
Adjusted R-sq	0.51	0.51	0.51
RepoType FE	YES	YES	YES
Dealer FE	YES	YES	YES
Fund FE	YES	YES	YES

Table 8. Difference-in-Difference: MMF reform on repo principal, N-SAR relationship ranking

Table 8 illustrates how MMF reform impacted repo principal (borrowing/lending volume) for relationship trades vs non-relationship trades. Relationship is a dummy variable that equals 1 if a dealer is the top3/5/10 larg est trading partner of an MMF in its NSAR form. Standard errors are clustered on the fund level. Prime is a dummy variable that equals 1 if the fund is a prime MMF

	(1)	(2)	(3)
VARIABLES	NSAR_top3	NSAR_top5	NSAR_top10
Prime	-0.39	-0.48	-0.35
	(0.42)	(0.42)	(0.40)
Relationship	0.27***	0.31***	0.22***
	(0.09)	(0.07)	(0.07)
Prime*Relationship	-0.28*	-0.34**	-0.30*
	(0.15)	(0.13)	(0.15)
After_Reform	-0.14	-0.19	-0.16
	(0.14)	(0.12)	(0.14)
Prime*After_Reform	-1.45***	-1.35***	-1.42***
	(0.23)	(0.23)	(0.24)
Relationship*After_Reform	-0.27**	-0.23**	-0.14
	(0.11)	(0.09)	(0.09)
Relationship*Prime*After_Reform	-0.09	0.07	0.16
	(0.31)	(0.22)	(0.24)
illiq	0.07	0.08	0.08
	(0.06)	(0.06)	(0.06)
tenor1	0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)
Constant	4.20***	4.06***	4.08***
	(0.19)	(0.20)	(0.20)
Observations	29,323	29,323	29,323
# of Portfolios	199	199	199
Adjusted R-sq	0.14	0.14	0.14
RepoType FE	YES	YES	YES
Dealer FE	YES	YES	YES
Fund FE	YES	YES	YES

Table 9. Bargaining Power of MMFs

Table 9 illustrates how repo rate changes with the dealer dependence measure from Han and Nikolaou (2016), which is defined as the ratio of total repo trade volume of a dealer with its relationship fund to total repo trade volume of that fund in that month. Relationship is a dummy variable that equals 1 if this ratio is in the top 1/3rd percentile either based on past 1-month (Volume_1m) transactions, or past 3-month (Volume_3m) transactions. Prime is a dummy variable that equals 1 if the fund is a prime MMF

VARIABLES	(1) Volume_1m	(2) Volume_3m
Prime	-2.31	1.24
	(2.58)	(2.47)
Relationship	0.03	0.03
	(0.02)	(0.02)
Prime*Relationship	-0.33***	-0.48***
	(0.09)	(0.09)
After_Reform	-0.65	-0.72
	(0.97)	(0.96)
Prime*After_Reform	6.17***	3.69**
	(2.06)	(1.83)
Relationship*After_Reform	-0.09***	-0.08**
	(0.03)	(0.03)
Prime*Relationship*After_Reform	**0.91*** **	**0.99*** **
	(0.15)	**(0.15)**
Principal	0.58***	0.61***
	(0.17)	(0.16)
Illiquid	15.45***	15.43***
	(3.84)	(3.83)
Tenor	0.20***	0.20***
	(0.07)	(0.07)
Fed_rate	0.93***	0.95***
	(0.01)	(0.01)
Constant	24.70***	24.43***
	(4.16)	(4.12)
Observations	29,323	29,323
# of Portfolios	199	199
Adjusted R-sq	0.85	0.85
RepoType FE	YES	YES
Dealer FE	YES	YES
Fund FE	YES	YES

Table 10. Bargaining Power of Dealers

Table 10 illustrates how repo rate changes with the fund dependence measure from Han and Nikolaou (2016), which is defined as the ratio of total repo trade volume of a fund with its relationship dealer to total repo trade volume of that dealer in that month. Relationship is a dummy variable that equals 1 if this ratio is in the top 1/3rd percentile either based on past 1-month (Volume_1m) transactions, or past 3-months(Volume_3m) transactions. Prime is a dummy variable that equals 1 if the fund is a prime MMF

VARIABLES	(21) Volume_1m	(25) Volume_3m
Prime	-6.34**	-6.52**
	(2.82)	(2.83)
Relationship	0.03	0.06
	(0.04)	(0.05)
Prime*Relationship	0.24***	0.29***
	(0.05)	(0.06)
After_Reform	-1.83*	-1.77**
	(0.94)	(0.87)
Prime*After_Reform	17.59***	17.84***
	(2.29)	(2.31)
Relationship*After_Reform	0.03	0.03
	(0.04)	(0.04)
Prime*Relationship*After_Reform	**-0.41*** **	**-0.47*** **
	(0.13)	**(0.14)**
Principal	0.54***	0.53***
	(0.14)	(0.14)
Illiquid	15.35***	15.32***
	(3.82)	(3.80)
Tenor	0.20***	0.20***
	(0.07)	(0.07)
Fed_rate	0.94***	0.95***
	(0.01)	(0.01)
Constant	24.43***	23.94***
	(4.18)	(4.09)
Observations	29,305	29,323
# of Portfolios	199	199
Adjusted R-sq	0.85	0.85
RepoType FE	YES	YES
Dealer FE	YES	YES
Fund FE	YES	YES

Table 11. Robustness Check: Add dealer liquidity coverage ratio (LCR) and trading leverage

Table 11 illustrates that our DID result is not driven by dealer's financial slack variables such as liquidity coverage ratio, or trading leverage.

VARIABLES	(1) NSAR_top3_DID	(2) control_LCR	(3) control_leverage
Prime	-1.06	-0.21	-0.21
	(2.45)	(2.32)	(2.31)
Relationship	2.93***	2.50***	2.52***
	(1.12)	(0.93)	(0.91)
Prime*Relationship	-2.84**	-3.28***	-3.26***
	(1.41)	(1.22)	(1.23)
After_Reform	-1.62	-1.49	-1.49
	(1.12)	(1.12)	(1.13)
Prime*After_Reform	9.62***	8.18***	8.17***
	(1.34)	(1.51)	(1.55)
Relationship*After_Reform	-2.24**	-1.62*	-1.64*
	(1.09)	(0.89)	(0.88)
Prime*Relationship*After_Reform	**-4.05***	**-3.82***	**-3.84***
	(2.13)	**(2.04)**	**(2.06)**
Principal	0.46***	0.42**	0.42**
	(0.16)	(0.18)	(0.18)
Illiquid	28.71***	27.71***	27.71***
	(3.55)	(3.59)	(3.57)
Tenor	0.19***	0.18***	0.18***
	(0.07)	(0.07)	(0.07)
Fed_rate	0.96***	0.97***	0.97***
	(0.01)	(0.01)	(0.01)
LCR		-0.02	
		(0.24)	
TRADE_LEVERAGE			-1.33
			(2.93)
Constant	23.24***	24.22***	24.47***
	(4.09)	(5.39)	(3.61)
Observations	14,627	14,675	14,675
# of Portfolios	192	197	197
Adjusted R-sq	0.86	0.86	0.86
RepoType FE	YES	YES	YES
Dealer FE	YES	YES	YES
Fund FE	YES	YES	YES

Table 12. Robustness Check: Fund Outflow Events (15% outflow)

	15% Outflow			
	(1)	(2)	(3)	(4)
VARIABLES	after_reform	after_reform	before_reform	before_reform
Relationship	1.01***	1.16***	1.56***	1.39***
	(0.36)	(0.36)	(0.33)	(0.35)
Outflow	1.22***	1.53***	1.25***	0.95**
	(0.46)	(0.48)	(0.39)	(0.43)
Relationship*Outflow		**-2.71****		**1.66***
		(1.32)		**(0.96)**
Principal	-0.18**	-0.18**	0.40***	0.40***
	(0.08)	(0.08)	(0.09)	(0.09)
Illiquid	15.40***	15.41***	23.20***	23.20***
	(0.44)	(0.44)	(0.39)	(0.39)
Tenor	0.25***	0.25***	0.25***	0.25***
	(0.01)	(0.01)	(0.01)	(0.01)
Fed Rate	0.97***	0.97***	0.78***	0.78***
	(0.01)	(0.01)	(0.01)	(0.01)
Constant	-1.73	-1.81	4.17***	4.19***
	(1.16)	(1.16)	(0.82)	(0.82)
Observations	20,783	20,783	18,951	18,951
Number of Portfolios	155	155	116	116
Adjusted R-squared	0.72	0.72	0.62	0.62
Fund FE	YES	YES	YES	YES
Dealer FE	YES	YES	YES	YES

Table 12 (continued). Robustness Check: Fund Outflow Events (10% outflow)

	10% Outflow			
	(1)	(2)	(3)	(4)
VARIABLES	after_reform	after_reform	before_reform	before_reform
Relationship	1.01***	1.18***	1.57***	1.34***
	(0.36)	(0.37)	(0.33)	(0.36)
Outflow	0.96**	1.20***	0.92***	0.64*
	(0.39)	(0.41)	(0.34)	(0.37)
Relationship*Outflow		**-2.25****		**1.56***
		(1.13)		**(0.82)**
Principal	-0.18**	-0.18**	0.40***	0.40***
	(0.08)	(0.08)	(0.09)	(0.09)
Illiquid	15.41***	15.41***	23.20***	23.20***
	(0.44)	(0.44)	(0.39)	(0.39)
Tenor	0.25***	0.25***	0.25***	0.25***
	(0.01)	(0.01)	(0.01)	(0.01)
Fed Rate	0.97***	0.97***	0.78***	0.78***
	(0.01)	(0.01)	(0.01)	(0.01)
Constant	-1.72	-1.81	4.17***	4.20***
	(1.16)	(1.16)	(0.82)	(0.82)
Observations	20,783	20,783	18,951	18,951
Number of Portfolios	155	155	116	116
Adjusted R-squared	0.72	0.72	0.62	0.62
Fund FE	YES	YES	YES	YES
Dealer FE	YES	YES	YES	YES

Table 12 (continued). Robustness Check: Fund Outflow Events (5% outflow)

	5% Outflow			
	(1)	(2)	(3)	(4)
VARIABLES	after_reform	after_reform	before_reform	before_reform
Relationship	1.01***	1.24***	1.57***	1.38***
	(0.36)	(0.38)	(0.33)	(0.37)
Outflow	0.56*	0.75**	0.48*	0.35
	(0.30)	(0.31)	(0.26)	(0.29)
Relationship*Outflow		**-1.61***		**0.82**
		(0.84)		**(0.67)**
Principal	-0.18**	-0.18**	0.40***	0.40***
	(0.08)	(0.08)	(0.09)	(0.09)
Illiquid	15.40***	15.42***	23.20***	23.20***
	(0.44)	(0.45)	(0.39)	(0.39)
Tenor	0.25***	0.25***	0.25***	0.25***
	(0.01)	(0.01)	(0.01)	(0.01)
Fed Rate	0.97***	0.96***	0.78***	0.78***
	(0.01)	(0.01)	(0.01)	(0.01)
Constant	-1.71	-1.77	4.18***	4.20***
	(1.16)	(1.16)	(0.82)	(0.82)
Observations	20,783	20,783	18,951	18,951
Number of Portfolios	155	155	116	116
Adjusted R-squared	0.72	0.72	0.62	0.62
Fund FE	YES	YES	YES	YES
Dealer FE	YES	YES	YES	YES

Table 13. Affected Dlear-Fund Pairs in Charles Schwab Sweep Funds Liquidation

2018-04	2018-09	2019-03
SWMXX-BARCLAYS	SWQXX-BARCLAYS	SWSXX-BARCLAYS
SWMXX-BMO	SWQXX-BMO	SWSXX-BMO
SWMXX-BNP	SWQXX-BNP	SWSXX-BNP
SWMXX-CREDIT AGRICOLE	SWQXX-CREDIT AGRICOLE	SWSXX-CREDIT AGRICOLE
SWMXX-CREDIT SUISSE	SWQXX-CREDIT SUISSE	SWSXX-CREDIT SUISSE
SWMXX-DEUTSCHE	SWQXX-DEUTSCHE	SWSXX-DEUTSCHE
SWMXX-GOLDMAN SACHS	SWQXX-GOLDMAN SACHS	SWSXX-GOLDMAN SACHS
SWMXX-JP MORGAN	SWQXX-JP MORGAN	SWSXX-JP MORGAN
SWMXX-MERRILL LYNCH	SWQXX-MERRILL LYNCH	SWSXX-MERRILL LYNCH
SWMXX-MIZUHO	SWQXX-MIZUHO	SWSXX-MIZUHO
	SWQXX-MORGAN STANLEY	
SWMXX-RBC	SWQXX-RBC	SWSXX-RBC
SWMXX-SCOTIA	SWQXX-SCOTIA	SWSXX-SCOTIA
SWMXX-WELLS FARGO	SWQXX-WELLS FARGO	SWSXX-WELLS FARGO

Note: SWMXX was liquidated Apr.2018, SWQXX was liquidated Sept.2018, SWSXX was liquidated March.2019.

Table 14. Most Affected Dealers in Charles Schwab Sweep Funds Liquidation

	Repo Trade with Charles Schwab/Total Repo Trade (%)
CREDIT SUISSE	**9%**
WELLS FARGO	**6%**
BARCLAYS	**4%**
RBC	**4%**
SCOTIA	3%
BNP	2%
MERRILL LYNCH	2%
MIZUHO	2%
JP MORGAN	2%
BMO	1%
CREDIT AGRICOLE	1%
GOLDMAN SACHS	1%

Table 15. Repo Rate Diff-in-Diff: Charles Schwab Liquidation Case

VARIABLES	(1)	(2)	(3)
Post_Liquidation	2.89***	2.89***	2.81***
	(0.49)	(0.49)	(0.48)
Affected_Dealers		-2.21**	-3.81***
		(1.07)	(1.08)
Affected_Dealers*Post_Liquidation			**2.76*** **
			(0.65)
Principal	0.65*	0.65*	0.65*
	(0.37)	(0.37)	(0.37)
Illiquid	16.53***	16.53***	16.53***
	(4.89)	(4.89)	(4.89)
Tenor	0.10	0.10	0.10
	(0.08)	(0.08)	(0.08)
Fed Rate	1.13***	1.13***	1.13***
	(0.01)	(0.01)	(0.01)
Fund Size	-0.43***	-0.43***	-0.43***
	(0.14)	(0.14)	(0.14)
Dealer Size	0.31	0.31	0.31
	(0.20)	(0.20)	(0.20)
Constant	1.95	2.01	2.05
	(2.96)	(2.96)	(2.96)
Observations	56,713	56,713	56,713
Number of ticker_code	53	53	53
RepoType FE	YES	YES	YES
Dealer FE	YES	YES	YES

Clustered standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1