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Treasury Tri-party Repo Pricing

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Why These Findings Are Important

The U.S. tri-party repurchase agreement (repo) market is a vast, over-the-counter venue that facilitates more than $2 trillion in daily funding and central bank open market operations. Despite its critical role, pricing within this market remains misunderstood. This OFR Working Paper addresses that discrepancy by leveraging a comprehensive transaction-level dataset to examine how market frictions influence tri-party repo pricing. Notably, what impacts pricing for a firm is (1) the number of counterparties traded with, (2) the degree of diversification across those counterparties, and (3) the share of trading activity those counterparties represent.

Key Findings

1. **Despite repos having negligible maturity, collateral, and counterparty risk, there is significant variation in the prices market participants receive.**

2. **Trading relationship frictions coincide with the rates lenders and borrowers receive.**

3. **Relationships prove especially impactful during periods of market stress when lenders experience increased bargaining power.**

How the Authors Reached These Findings

The authors combine supervisory data from tri-party general collateral repo transactions with settlement data on the collateral securing these transactions. This allows them to observe both rates and haircuts, enabling a more effective assessment of funding costs that previous studies did not consider. Additionally, these data provide insight into counterparty relationships, which is key to determining the prices market participants receive.

Treasury Tri-Party Repo Pricing*

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ABSTRACT

The U.S. tri-party repurchase agreement (repo) market segment is a large over-the-counter venue critical for more than $2 trillion in daily funding and central bank open market operations. Using a confidential and comprehensive dataset, this paper examines the pricing of overnight tri-party repos, a key input to the U.S. Secured Overnight Financing Rate benchmark. Despite these transactions having negligible maturity, collateral, and counterparty risk, there is significant variation in the prices that market participants receive, which depend on (1) the number of counterparties they frequently trade with, (2) the degree of diversification across those counterparties, and (3) the share of trading activity those counterparties represent. Notably, during periods of market stress, these features can significantly alter the pricing impact experienced by borrowers.

Keywords: tri-party repos, treasury repos, short-term funding, over-the-counter markets.
JEL classification: E44, E51, G24, L14.

The U.S. tri-party repurchase agreement (repo) market is a large, over-the-counter (OTC) market accounting for more than $2 trillion in daily transactions. This market provides a unique venue in which a diverse set of institutions invest their cash and obtain large amounts of funding on a daily basis.[1] Beyond its important funding role, this market plays a critical function in U.S. monetary policy as it is used by the Federal Reserve (Fed) to influence rates through open market operations. Overnight transactions collateralized with U.S Treasuries, or overnight tri-party repos, are also important as their rates serve as a key input to the Secured Overnight Financing Rate (SOFR).

Despite its significance, pricing in this market remains imperfectly understood, largely due to the absence of publicly available disaggregated data. By leveraging a confidential, comprehensive transaction-level dataset, we aim to fill this gap by empirically studying how frictions in this market can alter tri-party repo pricing.

The bilateral nature of repos means that participants privately negotiate terms, each with partial knowledge about the terms available to others. As a result, prices can be influenced by participants' private information, preferences, and alternative trading opportunities. Also, because repos resemble collateralized loans, factors such as collateral, loan maturity, and counterparty risk can affect prices. To remove the impact of as many factors as possible, we deliberately focus on overnight Treasury tri-party repos where considerations about maturity, collateral, and counterparty risk are likely to be negligible.[2]

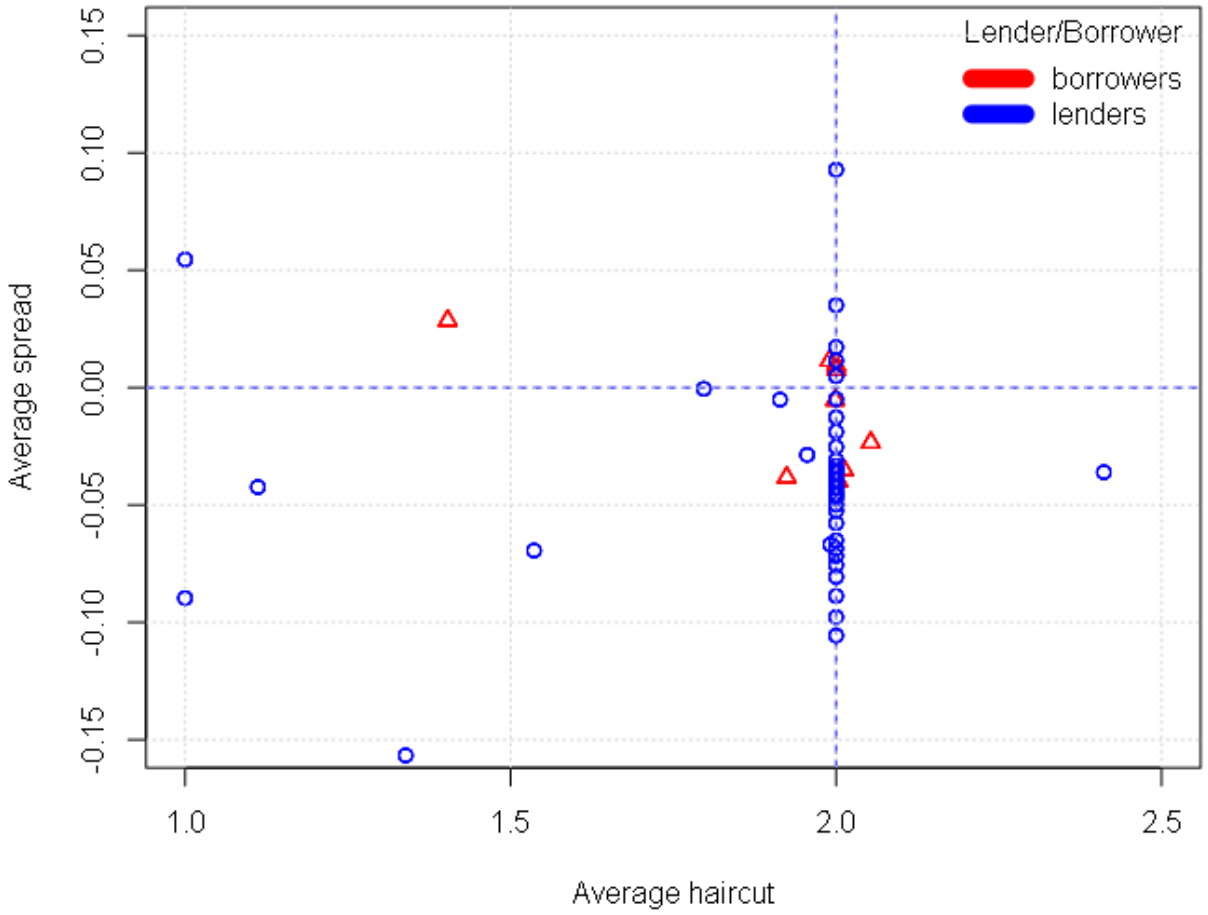
Contrary to the common view that rates and haircuts—a measure of overcollateralization—of overnight Treasury tri-party repos are somewhat homogeneous across market participants, we document significant cross-sectional variation in both. We find that different borrower-

[1]Besides providing a key source of short-term funding, this market plays a pivotal role in the functioning of the financial system by supporting the liquidity of U.S. Treasury and agency securities. Market participants include money market funds, hedge funds, government-sponsored enterprises (GSEs), primary and non-primary dealers, commercial and federal home loan banks, and municipalities.

[2]Transactions that are overnight do not have maturity or collateral concerns because transactions are collateralized with U.S Treasuries and, since tri-party repos are general collateral settled, cash-lenders are less likely interested in engaging in repos as a way to borrow specific securities. Counterparty risk is also minimal as most cash-borrowers are high-credit quality institutions and the collateral is held by a custodian bank throughout the loan (see Hu et al. (2021)). Thus, from a cash-lender's perspective, these short-term loans are essentially risk-free.

lender pairs consistently engage in similar transactions at different prices. Figure 1 illustrates this dispersion. We show that the rate and haircut at which participants trade can vary according to (1) the number of counterparties they frequently trade with, (2) the degree of trading diversification across those counterparties, and (3) the share of trading volume those counterparties account for. Additionally, we find that market stress can significantly alter the impact of these factors. Our results are robust to a battery of controls.

Figure 1. Average Pricing of Overnight Treasury Tri-Party Repos



Note: By depicting the average spread, which is a proxy for repo rates that corrects for changes in monetary policy (defined as the difference between repo and federal funds target midpoint rate), and haircuts across participants, this figure shows that prices of overnight tri-party repos are quite heterogeneous across market participants. For confidentiality, each point represents the tuple (average spread, average haircut) for a group of five participants with similar characteristics. Averages are taken across transactions of non-consecutive years and participants. Participants that exhibit similar tuples (average spread, average haircut) are categorized within the same group. Blue circles represent lenders while red triangles represent borrowers. Spreads and haircuts are in percentages. The figure depicts tuples that lie within the region $[1\%, 2.5\%] \times [-0.15\%, 0.15\%]$. *Source*: Federal Reserve Tri-Party Repo Collection, BNYM Tri-Party Repo Settlement, Authors analysis.

Our empirical findings are broadly aligned with results of search-and-bargaining models, as in Duffie et al. (2005, 2007), Afonso and Lagos (2015), Gavazza (2016) and Üslü (2019); models of information percolation and asymmetric information as in Duffie and Manso (2007), Duffie et al. (2010a, 2009, 2010b), and Duffie et al. (2014); and models of liquidity preferences and imperfect competition as in Huber (2023). By identifying the key factors that shape bargaining power in overnight tri-party repos, we offer a new perspective on how prices are determined in this important market. Our findings also enhance our understanding of pricing in decentralized funding markets wherein counterparty risk, maturity, or collateral concerns are likely to play secondary roles. Our insights have practical implications for policymakers because they shed light on the sources of price dispersion in short-term funding markets, informing discussions related to monetary policy and benchmark rate setting.

At a fundamental level, our findings suggest that three factors influence a participant's bargaining power in overnight tri-party repos: (1) the availability of alternative trading opportunities, (2) the ease with which information spreads across participants, and (3) participants' preferences for stable funding/lending.

We start by examining how rates vary across market participants. For the average borrower, higher rates are asssociated with a borrower that (a) borrows from more lenders than usual, (b) in a more concentrated fashion, or (c) from less active lenders that are defined as those with trading volume representing a lower share of the market. Borrowing from one additional lender than usual is associated with a 1 basis point (bp) rate increase, which accounts for about $1.3 million more in annual funding costs. A 1% increase in borrowing concentration (as measured by a Herfindahl index of a borrower's trading with their counterparties) is associated with a 0.105 bp rate increase and represents about $136,000 more in annual funding costs. With that said, a 1% decrease in the market share of a borrower's counterparties (as measured by the percentage of total trading volume associated with those counterparties) is associated with a 0.044 bps rate increase, representing about $57,000 more in annual funding costs.

Interestingly, we find different results among lenders. For the average lender, lending to more active borrowers which are defined as those with trading volume that represents a higher share of the market, is associated with higher rates. A 1% increase in the market share of counterparties is associated with a 0.218 bp rate increase and accounts for about $93,000 additional annual interest earnings.

These findings are consistent with four simple ideas. First, searching more intensively than usual reveals liquidity strains among borrowers, making lenders charge a premium, which is aligned with the ideas in Zhu (2012).[3] Second, borrowing in a more diversified fashion decreases each counterparty's bargaining power, allowing the average borrower to negotiate lower rates. Third, trading with more active lenders allows borrowers to obtain funding at lower costs, as such lenders are likely to have greater access to funds. Fourth, borrowers with higher funding demand are willing to pay a premium to secure funding.

We next examine how haircuts vary across market participants. For borrowers, we find that consistently borrowing in a more concentrated fashion and from more active lenders is associated with higher haircuts. Those with a 1% higher borrowing concentration than the average borrower pay 0.189 bp more in haircuts, which accounts for around $245,000 more in annual funding costs. And borrowers whose counterparties have market shares that are 1% higher than the market share of counterparties of the average borrower post 0.069 bp more in haircuts, which represents around $89,000 more in annual funding costs. In contrast, neither lending concentration nor counterparties' market share affects haircuts for the average lender.

Given the OTC nature of the tri-party repo market, we then study whether our results depend on participants' searching ability—represented by the number of counterparties they can potentially trade with.[4] Our evidence suggests that the number of potential counterparties

[3] Zhu (2012) shows that if a participant returns to a counterparty from whom quotes have already been obtained, such a counterparty infers that the participant has had difficulty obtaining better trading terms from other counterparties. As a result, the counterparty is likely to offer even less attractive quotes to the participant.

[4] To trade in the tri-party repo market, participants must sign bilateral agreements beforehand. Those (lender, borrower) pairs with no such agreements at t cannot trade bilaterally at t. For a given participant, we define the set of potential counterparties as the number of different counterparties that the participant trades with over our sample.

matter, highlighting the role that limited opportunities to trade can play in pricing. To facilitate our analysis, we categorize borrowers and lenders into two groups: those with fewer potential counterparties than the median participant (less connected) and those with more counterparties (well connected).

We first explore how our results vary across borrowers. For the average well-connected borrower, all our factors matter for rates, and their pricing impact are higher than those for the average borrower in our sample. Yet for the average less-connected borrower none of our factors materially alter rates. These findings are consistent with three simple ideas. Well-connected borrowers tend to trade more actively, with more counterparties, and in a more diversified fashion, while the opposite applies to less-connected borrowers. Hence, variation in our variables is more likely to play a role only among well-connected borrowers. For them, searching more intensively and trading with less-active lenders can serve as signals of liquidity strains. Also, increasing borrowing concentration increases their counterparties' bargaining power, making it more difficult to raise funds at lower prices.

We then explore how our results vary across lenders. For the average less-connected lender, the impact of its counterparties' market share is higher than that for the average lender in our sample. Among well-connected lenders, lending to more borrowers and in a less concentrated fashion is associated with lower rates. These findings further support the idea that borrowers with higher funding demand are willing to pay a premium to secure their funding, even when their counterparties might not be well connected. For well-connected lenders, lending to more borrowers than usual might be interpreted as a signal of excess liquidity and, as a result, associated with lower rates.

Finally, we explore whether the pricing impact of our factors can be reshaped in times of stress. For borrowers, only the impact of their counterparties' market share changes. Borrowers pay higher rates when trading with more active lenders. For lenders, we find that only the impact of lending diversification changes in times of stress. Lending in a more diversified fashion allows lenders to obtain higher rates in periods of stress. These results are

consistent with the view that bargaining power tilts toward lenders in times of stress.

Related literature. Our paper contributes to four strands of the literature. First, it relates to a few other studies that have explored pricing in the tri-party repo market. Within this literature, Han et al. (2022) is the most closely related to our work. Focusing on transactions among the top dealers and money market funds, Han et al. (2022) highlights the role that relationships play on volumes and rates of overnight tri-party repos. When compared to Han et al. (2022), our analysis considers a larger and more comprehensive sample. Although some of our data come from the same regulatory source, we also have access to disaggregated information on collateral and haircuts—while they do not. We also include more years (with all available days within our sample) and transactions among a larger set of participants. We are also related to Hu et al. (2021) within this literature. Using information available in forms N-MFP, Hu et al. (2021) studies the trading and pricing of repos backed by risky collateral, especially equity repos. When compared to Hu et al. (2021), our focus not only differs from theirs, but also our data are more representative of the overnight market. This is because (1) their focus is on equity repos, which represent a negligible fraction of trading volume in overnight tri-party repos, and (2) our data are considerably more disaggregated than the information available in forms N-MFP.

Second, our paper relates to the literature that studies repos during periods of stress. An incomplete list of papers includes Gorton and Metrick (2012), Krishnamurthy et al. (2014), Begalle et al. (2013), Copeland et al. (2014), Gorton et al. (2020), Hüser et al. (2024), and Anbil et al. (2021). Within this literature, Anbil et al. (2021) is the most closely related to our work. Anbil et al. (2021) documents that trading relationships mitigate rate dispersion between different repo market segments, and that restricted access across such segments can increase market fragility. Though our paper and this literature share an emphasis on how periods of stress can alter the normal functioning of repo markets, our granular data allow us to provide a more precise list of the factors affecting tri-party repo pricing.

Third, our paper relates to the literature that provides a descriptive account of repo

markets. An incomplete list includes Copeland et al. (2010), Adrian et al. (2011), Copeland et al. (2012), Baklanova et al. (2015), Committee on the Global Financial System (2017), and Baklanova et al. (2019). We contribute to this literature by providing an updated description of the overnight tri-party repo market.

Fourth, we also contribute to the literature that studies pricing in decentralized markets by assessing the empirical validity of various theoretically motivated hypotheses.[5] Within this literature, our results are closely related to Duffie et al. (2005, 2007), Duffie and Manso (2007), Duffie et al. (2010a, 2009, 2010b), Afonso and Lagos (2015), Gavazza (2016), Üslü (2019), Duffie et al. (2014), and Huber (2023). Information percolation and search help us understand how changes in the number of counterparties may spread information about liquidity strains and modify participants' bargaining power. Models of liquidity preference and imperfect competition help us understand how preferences for stable borrowing/lending may alter participants' bargaining power, thereby affecting their trading behavior and prices.

Outline. The remainder of our paper is organized as follows. To help contextualize our results, Section I provides a brief institutional background of the U.S. repo market, with an emphasis on its tri-party segment. Section II describes our data. Section III describes our empirical hypotheses. Section IV empirically explores theoretically motivated factors affecting overnight tri-party repo pricing. Section V studies how the pricing impact of these factors changes during periods of stress. Section VI concludes. The Online Appendix contains additional information about the tri-party repo market as well as robustness tests.

[5]Other relevant literature includes Wolinsky (1990), Blouin and Serrano (2001), Green et al. (2006), Ashcraft and Duffie (2007), Duffie (2011), Golosov et al. (2014), Ballensiefen et al. (2023), and Chang et al. (2025). Our paper is also broadly related to the literature on collateralized debt. An incomplete list includes Stiglitz and Weiss (1981), Besanko and Thakor (1987), Berger and Udell (1990), Boot et al. (1991), Benmelech and Bergman (2009), Berger et al. (2011), Ennis (2011), Bottazzi et al. (2012), Simsek (2013), Berger et al. (2016), Gottardi et al. (2019), Parlatore (2019), Infante (2019), Infante (2020), and Huh and Infante (2021).

I. Institutional Background

This section provides a brief overview of the U.S. repo market and its tri-party segment. A repo is the sale of an asset (or portfolio of assets) combined with an agreement to repurchase it on a future date at a prearranged price. At a simpler level, a repo resembles a collateralized loan in which one party, or the lender, lends cash against the collateral of the other party, the borrower. Collateral aims to protect lenders against the risk that borrowers fail to repay the loan.

In the U.S., the repo market has four segments in which transactions are either (1) settled on the books of a third party or (2) settled on a DVP basis, wherein the lender returns the collateral while the borrower repays the cash plus interest at settlement. Among these segments, two rely on a third party for settlement. First, there is a non-centrally cleared segment wherein trades are bilaterally negotiated, traditionally referred to as the tri-party repo market, which is the focus of our paper. Second, there is the GCF repo market in which trade matching and netting services are provided by the Fixed Income Clearing Corporation; thus, trades are blind-brokered. DVP transactions occur in two segments as well: centrally cleared DVP repos and uncleared DVP repos, which are typically referred to as bilateral repos.

The largest portion of the U.S. tri-party repo market is represented by its overnight segment. Within this segment, most lenders seek interest income at very short maturities. Most borrowers are large high-credit-quality institutions, and they tend to use repos to obtain large amounts of financing for investments and their lending to clients.

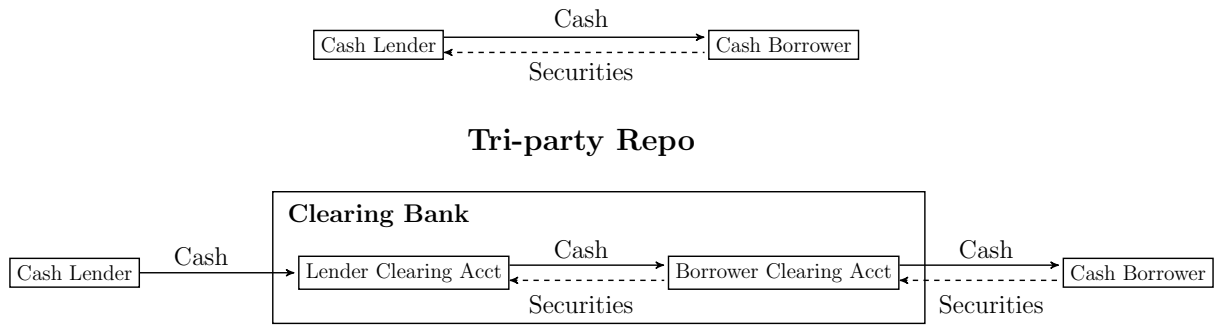
To trade in the tri-party repo market, counterparties must sign a master agreement beforehand. These agreements specify the general terms of future trades between both parties. They describe the types of collateral the lender is willing to accept and the haircuts associated with them. Haircuts, defined as the difference between the market value of (assets posted as) collateral and the loan amount, aim to protect lenders against changes in collateral value. Because the tri-party repo market is general collateral settled, participants are not necessarily

interested in specific securities.

Because not all lenders and borrowers have signed such master agreements, trading between a lender and a borrower might not be feasible; thus, trading opportunities vary across market participants. Although a participant might have agreements with several counterparties, it might decide to trade with only a subset of them for which the terms of trade are beneficial. Once transaction terms are agreed upon, which includes the interest rate on the loan, collateral class, and maturity (as haircuts are previously negotiated), the lender sends the cash to (its account with) the clearing bank while the borrower sends the collateral to (its account with) the clearing bank, for the duration of the trade.[6]

The structure of trading in tri-party generates two important differences between tri-party and bilateral repos.[7] First, tri-party is general collateral, and so, considerations about specific

Figure 2. Difference between Bilateral and Tri-Party Repos



Note: A repo resembles a collateralized loan in which the borrower seeks cash and posts an asset (or portfolio of assets) as collateral, while the lender receives such collateral when lending cash. At maturity, the borrower returns the cash plus interest to the lender, while the lender returns the collateral to the borrower. In bilateral repos, lenders and borrowers interact directly with each other and settle their transaction. Although tri-party repos are also bilaterally negotiated, transactions are settled through a clearing bank, which among other services, also provides custodian, collateral valuation, and back-office services.
Source: Authors' creation.

[6]The interest rate on a repo is calculated from the difference between the sale price and the repurchase price of the assets collateralizing the repo and can be negotiated on either a fixed or floating rate basis. Besides haircuts, repo transactions specify the terms, including the specific securities acceptable as collateral and initial margin requirements if necessary. Although most tri-party repos are overnight transactions, they can have longer maturities. Additionally, the clearing bank is responsible for distributing the collateral to the lender's account based on what meets the terms of the negotiated trade, as tri-party is a general collateral market.

[7]In both types of repos, if the borrower fails to repay the cash, there is no need to enter a bankruptcy

securities are absent. Second, because collateral stays with the clearing bank along the duration of the trade, it cannot be rehypothecated (outside the tri-party repo market), as it might be in bilateral repos.[8] Figure 2 helps emphasize the differences between bilateral and tri-party repo transactions by illustrating how cash and collateral move from lenders to borrowers.

Importance of the clearing bank. Besides settling transactions, the clearing bank provides custodian, collateral valuation, margining, and back-office support to both parties. This ensures that the lender obtains the correct asset class, value, and haircut while confirming that any newly posted collateral meets the lender's requirements. Because the clearing bank handles most back-office tasks, it is easier for less-sophisticated institutions to engage in repo lending, which helps explain the large heterogeneity among lenders in the market.

Overnight tri-party repos as collateralized loans. Because tri-party repos resemble a collateralized loan, three basic factors could alter pricing: (1) counterparty risk, (2) the perceived quality of the collateral, and (3) loan maturity. Although these factors potentially play a role in general loan pricing, they are less likely to affect the pricing of overnight tri-party repos.

First, counterparty risk is somewhat negligible in tri-party repos, as loans are over collateralized, the clearing bank manages margin calls, and the central banks maintains a standing lending facility. Also, as highlighted in Anbil et al. (2021), this risk is considerably smaller in overnight tri-party repos relative to other collateralized markets. This is because most borrowers are high-credit-quality institutions, and lenders are likely to recoup their cash if their counterparty defaults.[9] Second, because U.S. Treasuries are highly liquid and the tri-party repo market is general collateral settled, the perceived quality of collateral is

process, as the lender can sell the collateral; both repo types are bankruptcy remote.

[8]Rehypothecation is the practice that allows a lender $\mathcal{L}$ to use the collateral posted by a borrower $\mathcal{B}$ as collateral in another repo transaction wherein $\mathcal{L}$ is now the borrower. Although rehypothecation is legally feasible within the tri-party repo market, we do not observe borrowers (lenders) switching to lenders (borrowers) throughout our sample. Thus, it is unlikely that rehypothecation plays any role in pricing.

[9]U.S. Treasuries seldom exhibit large price fluctuations over short periods of time, and lenders can sell the collateral without needing of enter a bankruptcy process.

unlikely to play a role in pricing, as rates are not affected by lenders' demands for specific securities. Third, because transactions are overnight, maturity considerations are unlikely to play a role in pricing.

II. Data Description

The Federal Reserve Board supervises tri-party clearing banks and, through the New York Fed, collects transaction-level data daily. Although the Bank of New York Mellon (BNYM) and JPMorgan Chase (JPMC) used to serve as the two clearing banks in the U.S. tri-party repo market, since 2019 BNYM has been the predominant clearing bank for U.S. government securities in tri-party. Because of JPMC's all but complete exit from the tri-party segment, our analysis focuses on transaction-level data from BNYM.

Our initial data contain all transactions from September 8, 2015, to March 9, 2021, and include information such as interest rate, loan amount, counterparties' accounts, collateral pledged, initiation date, and maturity date.[10] With these data, we apply the following filters to construct our baseline sample. First, we focus on overnight transactions, as they represent the largest portion of the market (wherein most institutions actively participate). Second, as in Han et al. (2022), we purposely focus on tri-party repos, which represent more than half of overnight trading volume. We apply these filters to obtain a more homogeneous sample by reducing the influence of maturity and collateral quality.[11] Finally, we remove duplicated observations and dates that resemble holiday activity levels.

[10] Our data also include information such as type of transaction; transaction effective date, whether the transaction has a fixed maturity; whether the transaction includes an option (e.g., the ability to extend or terminate early), and, if the transaction includes an option, the minimum notice period required to exercise it. Observations describe the flow of cash and collateral between BNYM accounts and are organized by the time submitted to BNYM. Because participants can have several accounts with BNYM and a single transaction might involve cash/collateral that is drawn from various accounts, a transaction may be represented by several observations in our sample. Online Appendix A provides a detailed description of how we uncover transactions from observations in our data.

[11] Applying this filter effectively allows us to reduce the influence of haircut heterogeneity and collateral quality. As tri-party is general collateral settled, rates are unlikely affected by lenders' demand for specific securities. Also, most lenders are willing to accept Treasuries, while many of them do not necessarily accept agencies or other types of collateral. Thus, by focusing on tri-party repos, we continue to consider the majority of participants in the market.

Table I reports summary statistics at the daily level for our baseline sample. Overall, we have data on 619,920 trades among 338 market participants over 1,350 days. These trades correspond to activity between 1,104 different lender-borrower pairs consisting of 50 borrowers and 288 lenders. On an average day, there are 460 trades among 369 different lender-borrower pairs accounting for 31 borrowers and 118 lenders. The average borrower raises about $15 billion per day while the average lender lends about $4 billion per day. The average borrower makes about 15 trades with 12 lenders per day while the average lender makes about 4 trades with 3 borrowers per day. Thus, the average lender interacts with considerably fewer counterparties than the average borrower. On an average day, borrowers raise around $445 billion and the (volume-weighted average) interest rate and haircut are around 1.02% and 1.58%, respectively.

Table II provides a complementary view by reporting summary statistics at the participant level. The average rate per trade among lenders is about 1.012%, with a haircut of 1.48% and a loan size of $772 million. Among borrowers, the average rate per trade is about 1.23% with a haircut of 1.865% and a loan size of $863 million. Table II highlights that trading with affiliated counterparties alters pricing and the size of the average transaction. For both lenders and borrowers, average rates and haircuts are considerably lower, while loan sizes are higher when trading with affiliated counterparties.[12]

By reporting the average daily activity of different types of participants, Table III helps illustrate their composition.[13] Consistent with Copeland et al. (2012), we find that money market funds account for an important fraction of lenders, while primary and non-primary

[12] Although convenient for borrowers from a pricing perspective, only about 10% of lenders and 30% of borrowers trade with affiliated counterparties throughout our sample.

[13] Although our classification of participants is considerably more granular—as it is based on names and trading activity of accounts as well as legal entity identifiers—for ease of exposition Table III presents statistics in which participants are classified into several major categories. Asset managers (e.g., money market funds and hedge funds), clearinghouses, commercial banks, the Fed, GSEs (e.g., Federal Home Loan Banks, Fannie Mae, Freddie Mac, etc.), municipalities (e.g., state and municipality treasurers), primary and non-primary dealers (i.e., government securities dealers that are permitted to trade directly with the Federal Reserve versus those that are not), and securities lending agents (i.e., banks or other market participants that facilitate securities lending transactions by offering their—or their clients'—available securities). Current and historical lists of primary dealers can be found here. Online Appendix A provides a detailed description of how we uncover participants in our data.

dealers account for the majority of borrowers. Notably, nearly all participants only act as either a lender or a borrower within our sample, with the Fed being the only participant that trades on both sides of the market.

Table IV underscores the relevance of having better access to alternative trading opportunities. Table IV shows that well-connected lenders, which are defined as those with more potential counterparties than the median lender, lend higher amounts, trade with more active borrowers, and obtain higher spreads (as measured by the difference between repo and Federal Open Market Committee (FOMC) mid-point rates) and haircuts than their less-connected counterparts. On the borrower side, well-connected borrowers which are defined in a similar fashion to their lender counterparts, borrow more, trade with more active lenders, and pay lower spreads but have higher haircuts than less-connected borrowers.

III. Empirical Hypotheses

Because of the bilateral nature of overnight tri-party repos, participants have partial information about the terms available to others when trading. Because counterparty risk, collateral, and maturity considerations are unlikely to play a role in their pricing, it must be the case that, all else beling equal, differences in participants' bargaining power are driven by either differences in (1) their private information, (2) preferences, or (3) alternative trading opportunities. Taken together, the theoretical literature suggests several mechanisms that could alter their pricing. We distill these mechanisms into three main hypotheses that we then use to guide our empirical analysis.[14]

First, having more alternative trading opportunities should play a role in tri-party repo pricing, as these transactions are negotiated in an OTC setting. Since participants trade

[14] An incomplete list of the theoretical literature exploring the relevant tradeoffs within collateralized debt and repo markets includes Stiglitz and Weiss (1981), Chan and Kanatas (1985), Besanko and Thakor (1987), Boot et al. (1991), Benmelech and Bergman (2009), Ennis (2011), Duffie (2011), Bottazzi et al. (2012), Dang et al. (2013), Simsek (2013), Eren (2014), Afonso and Lagos (2015), Allen et al. (2016), Gavazza (2016), Üslü (2019), Gottardi et al. (2019), Infante (2019), Parlatore (2019), Huh and Infante (2021), Huber (2023), Chebotarev (2023), and Chang et al. (2025).

with similar counterparties each day , trading with more counterparties than usual could generate both benefits and costs. Trading with more counterparties than usual might allow participants to find better trading terms, but searching more intensively than usual might reveal private information, making it more difficult to arrange beneficial trading terms later on.

Second, to the extent to which participants' market share serves as a proxy for their relative importance, heterogeneity in market share is likely to be associated with heterogeneity in bargaining power. Participants with higher market share might exhibit higher bargaining power, allowing them to negotiate better terms of trade, which could manifest in both rates and haircuts. Yet, higher market share might reflect participants' motives for trade. In this case, higher market share might be associated with lower bargaining power, especially when funding is scarce.

Third, consistently trading with more counterparties should make a participant less susceptible to changes in its counterparties' bargaining power, as its trading depends less on that with any given counterparty. Thus, counterparty diversification should alter pricing to the extent to which it serves participants as an insurance mechanism against unexpected changes in their counterparties' bargaining power.

IV. Treasury Tri-Party Repo Pricing

With the above hypotheses in mind, this section aims to uncover the key factors that likely determine pricing in overnight tri-party repos. We show that rates and haircuts at which participants trade can vary according to their number of counterparties, the market share of such counterparties, and the diversification of trading among those counterparties.

A. Measures of searching activity and bargaining power

This section describes the three measures we use to indirectly proxy for participants' bargaining power and searching activity. Motivated by Ashcraft and Duffie (2007) and Han et al. (2022), to proxy for participants' relative importance in the market, we use participants' market share- calculated as the fraction of daily trading volume a participant accounts for. We then take its logarithm to improve the distributional properties of our measure. Because of endogeneity concerns, we use lagged values of this variable as instruments when running our regressions.

To proxy for searching activity, we use the number of different counterparties a participant trades with per day. Because lenders and borrowers can be affiliated—and such affiliation generates differential pricing—we only consider the number of non-affiliated counterparties when capturing searching. As with our previous measure, we use lagged values of this variable when running our regressions.

To appreciate the relevance of consistently trading with counterparties, and its implications for bargaining, we compute the Herfindahl-Hirschman Index of participants' daily trading volume among their counterparties to proxy for their trading concentration. This measure ranges from zero to one, and it decreases as participants trade in a more diversified fashion with their counterparties. As with previous measures, we take its logarithm and use lagged values as instruments to address endogeneity concerns.

Correlation among variables of interest. Table V explores correlations among our variables of interest. It highlights that changes in (1) counterparties' market share, (2) the number of non-affiliated counterparties, and (3) trading concentration are all significantly associated with changes in spreads and with each other. Among lenders, lending higher volumes and trading with more borrowers are associated with higher spreads. Yet lending in a more concentrated fashion, and to more active borrowers, is associated with lower spreads. Among borrowers, trading with more lenders is associated with lower spreads. Borrowing in a more concentrated fashion, from more active lenders, and in higher volumes is associated with

higher spreads.

As expected, for both borrowers and lenders, there is a significant negative correlation between the number of non-affiliated counterparties and trading concentration. Trading volume is also positively correlated with the number of non-affiliated counterparties, but it is negatively correlated with trading concentration. Finally, counterparties' market share is also positively correlated with trading volume.

B. Determinants of overnight tri-party repo pricing

Prices are effectively determined by both rates and haircuts in repos. Although haircuts are negotiated before a transaction occurs, they do alter the overall trading terms of any given repo, as posting collateral is costly. By exploiting how rate heterogeneity across market participants varies over time, we explore how the aforementioned variables alter rates. We then study how these variables affect haircuts by exploiting haircut heterogeneity across market participants.

B.1. Rates

We run the following regression:

$$\log(Y_{it}) \quad = \quad X_{it}\beta + \varepsilon_{it}, \tag{1}$$

where there are observations on market participants (i) across days (t). X_{it} is a vector of explanatory and control variables at the participant and day level, while Y_{it} captures the dollar-weighted average rate negotiated by participant i at t in overnight tri-party repos. Explanatory variables include our proxies for (1) counterparties' market shares, (2) the number of (non-affiliated) counterparties, and (3) trading concentration across those counterparties. We use one-week lags as instruments to address endogeneity concerns. Because of the potential autocorrelation of our regressors, we cluster standard errors at the participant level; see Stock

and Watson (2008) and Petersen (2008).[15] Our set of controls and fixed effects implies that parameter β is estimated from time variation in the distribution of rates across participants.

Controls. Besides including fixed effects at the participant level, we use a battery of other controls. Our controls include month-end and quarter-end fixed effects to ensure seasonal events do not alter our results.[16] We also include FOMC-announcement-date fixed effects to control for unexpected changes in monetary policy.

To address concerns that variation in overall trading activity could affect our results, we control for total trading volume. We also control for participants' changes in trading volume between $t-1$ and t. This control aims to address concerns that changes in either liquidity needs (among borrowers) or excess liquidity (among lenders) could be driving our results.[17] To tackle concerns that intra-day considerations might affect our results, we also control for the (average) time of the day a participant arranges her transactions; see Ashcraft and Duffie (2007).

Because participants tend to obtain more beneficial terms when trading with affiliated counterparties, we control for the fraction of repos participants arrange with them. In addition, because transactions (with potentially different collateral classes) might be jointly negotiated, we control for the daily fraction of a participant's transactions collateralized with Treasuries. We do so to remove the pricing impact of other collateral classes in Y_{it}. We also include the FOMC mid-point rate to control for changes in monetary policy and the Fed's net borrowing activity to control for changes in bargaining power due to the Fed's open market operations; see Anderson and Kandrac (2018).

[15] In the presence of participant fixed effects, OLS, Fama-MacBeth, and Newey-West standard errors are biased. However, clustered standard errors are unbiased, as they account for the residual dependence created by the participant effect.

[16] For example, Munyan (2015) documents the existence of quarter-end seasonality in tri-party repos resulting from European dealers that shrink their balance sheets at quarter-ends to reduce their asset base used for leverage ratio calculations.

[17] Higher trading activity—due to changes in either liquidity needs or excess liquidity—can be correlated with changes in rates. If we do not include controls for these changes, we are likely to face an omitted variable problem. Consider, for example, the pair of variables "rates" and "number of relationships." When borrowers have higher liquidity needs, they are likely to search more actively among their counterparties and, as a result, might be able to achieve lower rates. Therefore, changes in liquidity needs affect both variables. So, failing to include controls for these changes could generate an omitted variable problem.

Borrowers. Table VI contains the results of our regression specification among different sets of borrowers. For completeness, the first six columns report different subsets of our explanatory variables, while our main results (and most robust specification) are reported in column 7.

Panel A shows that, for the average borrower, (1) trading with more lenders than usual, (2) borrowing in a more concentrated fashion, and (3) borrowing from less active counterparties is associated with higher rates. All else being equal, these findings are consistent with three simple ideas. First, increasing searching potentially reveals liquidity strains among borrowers, making lenders charge a premium. Second, borrowing in a more diversified fashion decreases the bargaining power of lenders, allowing the average borrower to negotiate lower rates; see Ballensiefen et al. (2023) and Huber (2023). And third, trading with more active lenders allows the average borrower to secure funding at lower rates, as the opportunity cost of cash might be lower among lenders with access to more funds.

Importantly, our estimates are economically significant. Borrowing from one additional lender is associated with a 1.07 bp rate increase, which accounts for about $1.3 million more in annual funding costs. An increase of 1% in borrowing concentration is associated with a 0.105 bp rate increase, representing about $136,000 more in annual funding costs. A 1% decrease in counterparties' market share is associated with a 0.044 bp rate increase, accounting for about $57,000 more in annual funding costs.[18]

Relevance of relationships: As described in Section III, having the option to trade with more counterparties could increase participants' bargaining power. Although signing master agreements with more lenders might be costly, not doing so can also be costly, as borrowers can instead arrange trades with a larger number of counterparties if needed. Thus, it is reasonable to expect that borrowers that can trade with many lenders face different pricing

[18]The average borrower in our sample raises about $13 billion per day. As a result, an increase of 1 bp accounts for $1.3 million more in funding costs—$13 \times 10^9 \times 10^{-4} = 13 \times 10^5 = 1.3 \times 10^6$. The computation for the impact of changes in borrowing concentration and counterparties' market shares follows a similar idea. An increase of 0.105 bp in borrowing concentration accounts for $136,000 more in funding costs—$13 \times 10^9 \times 0.105 \times 10^{-4} = 1.36 \times 10^5 = \$136,000$. A decrease of 0.044 bps accounts for $57,000 less in funding costs: $13 \times 10^9 \times 0.044 \times 10^{-4} = 0.57 \times 10^5 = \$57,000$.

than those that can trade with only a few.

Panels B and C of Table VI explore this idea by studying whether the pricing impact of our explanatory variables differs between these two types of borrowers. Panel B reports the results of our regression specification among less-connected borrowers that are defined as those that trade with fewer lenders than the median borrower throughout our sample.[19] As Column 7 shows, none of our explanatory variables materially alter pricing among less-connected borrowers. As shown in Table IV, less-connected borrowers tend to trade with only a few counterparties, and, in doing so, borrow in a somewhat concentrated fashion. Since their lenders are less active in the market, it is less likely that any of our explanatory variables play a role in their pricing.

Yet, as Column 7 in Panel C shows, all the above factors matter for pricing among well-connected borrowers that are defined as those that trade with more lenders than the median borrower throughout our sample. The marginal impact of these factors is higher for the average well-connected borrower than for the average borrower. First, borrowing from one more lender than usual is associated with a 1.3 bp rate increase, which accounts for about $2.6 million more in annual funding costs for the average well-connected borrower. Second, a 1% increase in borrowing concentration is associated with a 0.119 bp rate increase, which represents about $238,000 more in annual funding costs for the average well-connected borrower. Third, a 1% decrease in counterparties' market share is associated with a 0.073 bp increase in rates, representing about $146,000 more on annual funding costs for the average well-connected borrower.[20]

Taken together, these results are consistent with three simple ideas. First, well- connected borrowers are likely to reveal more information when searching more intensively, as they

[19] For any given borrower, we compute the number of different lenders she interacts with in the entire sample. The threshold is defined by the median of that distribution.

[20] The average well-connected borrower raises about $20 billion per day. Therefore, an increase of 1.3 bp accounts for $2.6 million more in funding costs: $20 \times 10^9 \times 1.3 \times 10^{-4} = 26 \times 10^5 = 2.6 \times 10^6$. In addition, an increase of 0.119 bp accounts for 238,000 more on funding costs: $20 \times 10^9 \times 0.119 \times 10^{-4} = 2.38 \times 10^5 = 238,000$. A decrease of 0.073 bp accounts for $146,000 less on funding costs: $20 \times 10^9 \times 0.073 \times 10^{-4} = 1.46 \times 10^5 = 146,000$.

interact with more counterparties and also trade relatively higher volumes, which is aligned with results in Liu and Wu (2017). Importantly, this is not necessarily true among less-connected borrowers. Therefore, only increased searching among well-connected borrowers might be interpreted as a signal of liquidity strains in the market. As a result, only their lenders and not those of less-connected borrowers would require a premium. Second, borrowing diversification might be difficult to achieve among less-connected borrowers as they do not interact with many counterparties. Hence, variation along this dimension is unlikely to alter pricing. However, increasing counterparty diversification might be beneficial among well-connected borrowers as the higher the number of counterparties, the lower the bargaining power of each of them. Third, well-connected borrowers are more likely to be connected with active lenders; hence, variation along counterparties' market share is likely to play a role in their pricing (when compared to less-connected borrowers, which have few options to raise funds).

Lenders. Table VII reports the results of our regression specification among different types of lenders. As before, the first six columns report different subsets of our explanatory variables, while our most robust specification is reported in Column 7.

Panel A in Table VII shows that, for the average lender, only their counterparties' market share alters their pricing. Lending from more active counterparties is associated with higher rates. This finding is consistent with the idea that borrowers with higher demand for funding are willing to pay a premium. Again, our estimate is economically significant. A 1% increase in counterparties' market share is associated with a 0.218 bp rate increase, accounting for about $93,000 more in annual interest earnings for the average lender.

Relevance of relationships: Panels B and C of Table VII investigate the role of lenders' connectivity on the impact of our explanatory variables. Panel B reports our results among less-connected lenders that are defined as those that trade with fewer borrowers than the median lender. As Column 7 in Panel B shows, counterparties' market share continues to be the only explanatory variable that matters for pricing among less-connected lenders. Notably,

the marginal impact of counterparties' market share is higher for the average less-connected lender than for the average lender in our sample. This finding further supports the idea that borrowers with higher demand for funding are willing to pay a premium to secure their financing, even when their counterparties might not be well connected.

Interestingly, Column 7 of Panel C of Table VII shows that something different happens among well-connected lenders that are defined as those that trade with more borrowers than the median lender. Here, counterparties' market share does not play a role, but lending concentration and the number of counterparties does. For the average well-connected lender, trading with more borrowers and lending in a less concentrated fashion are associated with lower rates, which aligns with the findings of Huber (2023).

The above findings are consistent with two simple ideas. First, lending to more borrowers than usual might be interpreted as a signal of excess liquidity. Because bargaining power is likely to tilt towards borrowers in normal times resulting from considerably more lenders than borrowers in the market, such a signal commands lower rates for the average well-connected lender. Second, increasing lending diversification is likely to yield lower rates when borrowers are willing to pay higher rates to ensure access to more funding, as highlighted in Kahn et al. (2023).

Again, our estimates are economically significant. First, lending to one more borrower than usual is associated with a 1.13 bp rate decrease, which accounts for about \$88,000 less on annual interest earnings for the average well-connected lender. Second, a 1% increase in lending concentration is associated with a 0.088 bp rate increase, representing about \$70,000 more in annual interest earnings for the average well-connected lender.

B.2. Haircuts

Although we do not directly observe master agreements, we can infer haircuts from transaction-level information. Because haircuts are determined when negotiating master agreements, which are seldom renegotiated, we now exploit cross-sectional heterogeneity

across market participants to study how haircuts can be altered by our explanatory variables. Specifically, we run the following regression:

$$\log(h_i) \quad = \quad Z_i\varphi + \epsilon_i, \tag{2}$$

where i denotes market participants. Z_i is a vector of explanatory and control variables at the participant level, computed as the average of most of the variables mentioned in section IV.B.1. Here, h_i captures the average dollar-weighted haircut negotiated by participant i in overnight tri-party repos. Our set of controls and fixed effects implies that parameter φ is estimated from (cross-sectional) variation in the distribution of average haircuts across participants.

Controls. To address concerns that differences in trading volume across participants could impact our results, we control for the average trading volume (computed at the participant level). We also control for the average time of day a participant trades to tackle concerns stemming from intra-day considerations. As participants tend to obtain better haircuts when trading with affiliated counterparties, we also control for the average fraction of trades with affiliated counterparties (also computed at the participant level). To capture whether differences in participation rates and activity in repos could be driving our results, we also control for the number of days participants trade in the market and the average fraction of their overnight tri-party trades collateralized with securities.

Borrowers. Table VIII reports results of our regression specification among different sets of borrowers. As before, the first six columns present different subsets of our explanatory variables, while our most robust specification is reported in Column 7.

Panel A in Table VIII shows that, with respect to the average borrower in our sample, participants that consistently borrow in a more concentrated fashion and from counterparties trading more actively tend to post more collateral. First, borrowers whose average borrowing concentration is 1% higher than the average borrowing concentration post 0.189 bp more in haircuts, which accounts for around $245,000 more in annual funding costs. Second,

borrowers whose average counterparties' market share is 1% higher than the average market share of counterparties associated with the average borrower post 0.069 bp more in haircuts, representing around $89,000 more in annual funding costs. These findings are consistent with the view that lenders do have some bargaining power when negotiating haircuts. Importantly, lenders' bargaining power is higher when (1) they consistently play a more active role in the market and (2) their borrowers depend more reliant on their funding.

Relevance of relationships: In Panels B and C of Table VIII, we investigate the role that connectivity among borrowers plays on the impact of our explanatory variables on haircuts. Panel B presents results among less-connected borrowers. Column 7 in Panel B shows that, among less-connected borrowers, counterparties' market share is the only explanatory variable that alters haircuts. This finding further supports the idea that lenders exert their bargaining power when negotiating haircuts. Such bargaining power is higher among lenders that consistently trade more actively.

Yet something different happens among well-connected borrowers. Column 7 in Panel C shows that only counterparty concentration alters their haircuts. Here, higher borrowing concentration is associated with lower haircuts. Although this result might seem counter-intuitive at first glance, it is consistent with the idea that tailored borrowing allows well-connected borrowers to secure cheaper funding because tailoring minimizes funding costs among transactions. Notably, only well-connected borrowers are able to take advantage of such tailoring given their large number of potential counterparties.

Lenders. Table IX reports the results of our regression specification among different types of lenders. In contrast to borrowers, Panel A in Table IX shows that none of our explanatory variables materially affect haircuts for the average lender in our sample. This result might be driven by the fact that most lenders trade with only a few counterparties in a somewhat stable fashion over time. Therefore, variation along averages of our explanatory variables is not sufficient to explain the variation observed in average haircuts.

Relevance of relationships: The above result also applies to less-connected lenders; see

Column 7 in Panel B. Yet, as Column 7 in Panel C shows, results are different for well-connected lenders. Here, lenders with a 1% lower average lending concentration associated with the average well-connected lender and obtain 0.184 bp more in haircuts. Lenders whose average counterparties' market share is 1% lower than the one exhibited by the average well connected lender obtain 0.142 bp more in haircuts.

These findings are consistent with two simple ideas. First, increasing lending diversification can be beneficial for well-connected lenders as it effectively increases their bargaining power when negotiating master agreements. Notably, this is not the case among less-connected lenders, as their number of potential counterparties is not sufficiently large. Second, it is more difficult to negotiate higher haircuts with active counterparties. This is because their bargaining power is likely to be high, as they have several options from where they can raise funds. Although lenders exert their bargaining power when negotiating haircuts, their ability to negotiate higher haircuts can be materially limited by their counterparties' alternative trading opportunities.

V. Pricing in Times of Stress

Given the critical role that overnight tri-party repos play in the day-to-day functioning of the U.S. financial system, it is important to understand how the impact of the aforementioned factors can be altered in times of stress. Besides showing that such an impact can materially change during these periods, our results suggest that bargaining power tilts toward lenders during market stress.

Motivated by the above results, we now estimate the following regression specification:

$$\log(Y_{it}) \quad = \quad X_{it} \times \mathbb{1}_t \mu + X_{it}\gamma + \mathbb{1}_t \theta + \widetilde{\varepsilon}_{it}, \tag{3}$$

where X_{it}, as in specification (1), represents our set of explanatory and control variables, Y_{it} captures the dollar-weighted average rate obtained by participant i at t, and $\mathbb{1}_t$ is an indicator

variable that equals one if t is a period of stress and zero otherwise. Periods of stress are defined as the right 5% tail of the distribution of daily (dollar-weighted) average spreads on overnight tri-party repos over the sample. Here, the coefficients of interest are the interaction terms contained within vector μ. This vector captures the change in pricing impact on Y_{it} of (1) the number of nonaffiliated counterparties, (2) counterparty concentration, and (3) counterparties' market shares during periods of stress.

Borrowers. Table X contains the results of specification (3) among different sets of borrowers in our sample. Column 7 in Panel A shows that, for the average borrower in our sample, only the impact of counterparties' market share varies in times of stress. We find that the average borrower obtains higher rates in times of stress when trading with more active lenders. This is consistent with the idea that bargaining power tilts toward lenders in times of stress despite tilting toward borrowers in normal times. Since active lenders provide a higher fraction of the overall funding in the market, it is reasonable to expect that such lenders would be able to exert their increased bargaining power when negotiating rates. Importantly, for the average borrower, the pricing impact of neither the number of counterparties nor borrowing diversification seem to materially change during times of stress.

With Panels B and C of Table X, we explore whether connectivity among borrowers plays a role in the way our explanatory variables affect rates in times of stress. As before, Panel B presents our results among less-connected borrowers while Panel C reports our results among well-connected borrowers. As the juxtaposition of Columns 7 of Panels B and C shows, the pricing impact of counterparties' market share is the only variable that changes in times of stress, and it only changes among less- connected borrowers. This result supports the view that well-connected borrowers can use their higher number of connections as an insurance mechanism to raise funding at a (relatively) low cost in times of stress. Because less-connected borrowers lack many trading options, they effectively face the change of bargaining power in times of stress.

Lenders. Table XI contains the results of specification (3) among different types of

lenders. Column 7 in Panel A shows that, for the average lender in our sample, the impact of none of our explanatory variables changes in times of stress. Yet Panels B and C show that something different happens as lenders' connectivity varies. Column 7 in Panel B shows that, for the average less-connected lender, trading with more borrowers marginally decreases rates in times of stress, which further emphasizes the importance of establishing stable relationships among less-connected lenders. Column 7 in Panel C shows that, for the average well-connected lender, interacting with more active borrowers commands higher rates. Increasing lending diversification yields higher rates in times of stress as well. These results are consistent with the view that higher connectivity allows lenders to profit from higher rates in times of stress, which is not the case for less-connected lenders. As our results suggest, it is beneficial for lenders to trade with borrowers having higher liquidity needs in a more diversified way to further exert their increased bargaining power in times of stress.

VI. Conclusion

Contrary to the common view that prices of overnight tri-party repos are somewhat homogeneous, we document significant heterogeneity across market participants. In line with the thrust of search-and-bargaining models of OTC markets, our findings are consistent with the idea that three factors can influence a participant's bargaining power in overnight tri-party repos: (1) the availability of alternative trading opportunities, (2) the ease with which information spreads across participants, and (3) participants' preferences for stable funding/lending. By helping to better understand pricing in this important market, our insights can inform discussions on monetary policy implementation and benchmark rate setting.

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Tables

Table I: Descriptive Statistics at Daily Level

	Mean	Std Dev	Min	10%	Median	90%	Max
Number of Lenders	118	9	94	105	119	126	159
average amount lent (in $billions)	3.80	0.69	2.35	2.97	3.77	4.63	6.52
average # trades	3.93	0.71	2.58	3.10	3.79	4.80	5.48
average # relationships	3.15	0.52	2.21	2.54	3.08	3.77	4.26
Number of Borrowers	31	6	22	24	33	38	40
average amount borrowed (in $billions)	14.6	2.61	9.9	11.7	14.1	18.3	26.6
average # trades	14.9	0.93	12.4	13.9	14.8	16.0	17.7
average # relationships	12.0	0.78	10.2	11.1	11.9	13.0	14.0
Volume (in $billions)	445	76	266	344	450	541	769
Number of Trades	460	76	330	366	455	557	612
Number of Relationships	369	56	270	297	368	441	485
Rates (%)	1.02	0.86	0.02	0.07	1.00	2.37	5.00
Haircut (%)	1.58	0.28	0.55	1.19	1.63	1.89	1.97

Note: This table reports average daily statistics of the overnight portion of BNYM's tri-party repo. The first 8 rows describe the daily participation of borrowers and lenders, the average size of transactions, the number of counterparties, and trades. Rows 9 through 11 report trading volume, the number of trades, and the number of borrower-lender relationships on a daily basis. Rows 12 and 13 report the daily average rate and haircut of repo collateralized with U.S. Treasury securities.
Source: Federal Reserve Tri-Party Repo Collection, BNYM Tri-Party Repo Settlement, Authors' analysis.

Table II: Descriptive Statistics at Participant Level

Panel A: Lenders												
	All trades				*Non-affiliated trades*				*Affiliated trades*			
	Mean	Median	Q1	Q3	Mean	Median	Q1	Q3	Mean	Median	Q1	Q3
rate (%)	1.012	1.032	0.597	1.267	1.086	1.101	0.678	1.343	0.906	1.016	0.436	1.138
spread (%)	-0.051	-0.048	-0.100	-0.026	-0.039	-0.042	-0.069	-0.018	0.006	0.000	-0.055	0.036
haircut (%)	1.480	2	1	2	1.864	2	2	2	1.182	1.942	0.015	2
volume ($M)	772.3	165.6	49.56	551.9	310.8	138.9	49.16	399.3	2800	1345	535.8	3759
Panel B: Borrowers												
	All trades				*Non-affiliated trades*				*Affiliated trades*			
	Mean	Median	Q1	Q3	Mean	Median	Q1	Q3	Mean	Median	Q1	Q3
rate(%)	1.230	1.175	1.042	1.405	1.252	1.213	1.045	1.410	1.027	1.016	0.734	1.117
spread(%)	-0.007	-0.025	-0.039	0.010	-0.010	-0.026	-0.040	0.003	-0.004	-0.002	-0.048	0.031
haircut (%)	1.865	2	1.976	2.004	1.946	2	2	2.008	1.163	1.535	0.066	1.998
volume ($M)	863.7	567.8	296.5	984.2	733.5	508.2	295.1	947.9	3383	1275	279.2	5051

Note: This table reports statistics at the participant level. We split transactions based on whether counterparties are affiliated or not. For each participant, excluding the Fed, we compute the average rate, spread, haircut, and volume across transactions. With that information, we construct this table. Column Mean reports the mean of the cross-sectional distribution of averages (across participants). The same idea applies to columns Median, Q1, and Q3. Q1 reports the first quartile while Q3 reports the third quartile of the cross-sectional distribution of averages. Among lenders, 22 trade with affiliates while 228 trade with non-affiliates. Among borrowers, 14 trade with affiliates while 46 trade with non-affiliates.
Source: Federal Reserve Tri-Party Repo Collection, BNYM Tri-Party Repo Settlement, Authors' analysis.

Table III: Overnight Market Participant Activity

	Lenders			
	# Accounts	# Participants	Volume	# Transactions
Asset Manager	40	29	262.7	756.9
Commercial Bank	132	64	1.6	7.2
Federal Reserve	2	2	68.2	249.7
GSE	28	16	30.3	9.3
Municipality	26	16	13.3	10.0
Securities Lender	291	51	88.8	31.8
	Borrowers			
	# Accounts	# Participants	Volume	# Transactions
Commercial Bank	17	16	81.4	83.8
Federal Reserve	1	1	55.3	11.7
Non-Primary Dealer	14	11	14.3	22.9
Primary Dealer	37	26	288.1	345.5

Note: This table reports statistics for major market participants. Column "# Accounts" reports the number of BNYM accounts associated with each market participant type. Column "# Participants" is the number of unique market participants trading by type based on our classification procedure. Column "Volume" reports the average daily sum of funding ($billions) per market participant type. Column "# Transactions" reports the average daily number of transactions associated with each market participant type.
Source: Federal Reserve Tri-Party Repo Collection, Authors' analysis.s.

Table IV: Lender and Borrower Daily Descriptive Statistics

Panel A: Lenders								
	Less Connected				*Well Connected*			
	Mean	Std. Dev.	Q1	Q3	Mean	Std. Dev.	Q1	Q2
Rate	1.258	0.597	1.035	1.593	1.198	0.389	1.115	1.231
Spread	-0.052	0.063	-0.080	-0.046	-0.048	0.047	-0.063	-0.042
Haircut	1.683	0.676	1.947	2.000	1.872	0.294	1.975	2.000
Non-Affiliated Borrowers	1.232	0.531	1.001	1.353	4.227	4.005	1.456	5.660
Trading Volume ($B)	0.909	2.010	0.068	0.528	5.058	9.622	0.271	3.528
Counterparties Market Share	0.042	0.021	0.033	0.049	0.041	0.014	0.034	0.049
HHI	0.897	0.158	0.890	1.000	0.588	0.271	0.374	0.829
Participation Rate	0.666	0.325	0.398	0.975	0.779	0.304	0.574	1.000
Panel B: Borrowers								
	Less Connected				*Well Connected*			
	Mean	Std. Dev.	Q1	Q3	Mean	Std. Dev.	Q1	Q3
Rate	1.429	0.288	1.199	1.531	1.141	0.084	1.121	1.145
Spread	-0.017	0.055	-0.051	0.005	-0.060	0.017	-0.063	-0.050
Haircut	1.890	0.375	1.992	2.000	1.840	0.455	1.905	2.012
Non-Affiliated Borrowers	3.391	2.748	1.250	4.492	15.955	6.921	11.988	19.755
Trading Volume ($B)	5.337	8.218	0.472	6.212	39.155	106.028	4.832	25.507
Counterparties Market Share	0.039	0.024	0.025	0.043	0.070	0.055	0.052	0.071
HHI	0.648	0.301	0.375	0.933	0.272	0.225	0.141	0.325
Participation Rate	0.764	0.331	0.610	1.000	0.991	0.029	1.000	1.000

Note: This table reports statistics for participants that trade with at least two counterparties throughout the sample. A lender is said to be less connected if, throughout the sample, they trade with less different counterparties than the median lender. Otherwise, such a lender is said to be well connected. Similar concepts apply to borrowers. Variable spread is computed as the difference between repo rates and the federal funds target mid-point rate.
Source: Federal Reserve Tri-Party Repo Collection, BNYM Tri-Party Repo Settlement, Authors' analysis.

Table V: Correlation Among Variables of Interest

	Lenders				
	Spread	# Non-affiliated Borrowers	HHI	Market Share	Volume ($B)
Spread	1				
# Non-affiliated Borrowers	0.0962***	1			
HHI	-0.121***	-0.770***	1		
Market Share	-0.157***	-0.0395***	0.109***	1	
Volume ($B)	0.0650***	0.688***	-0.348***	0.158***	1
	Borrowers				
	Spread	# Non-affiliated Lenders	HHI	Market share	Volume ($B)
Spread	1				
# Non-affiliated Lenders	-0.0645***	1			
HHI	0.0719***	-0.704***	1		
Market Share	0.0536***	0.177***	-0.0785***	1	
Volume ($B)	0.0293***	0.628***	-0.275***	0.480***	1

Note: This table reports pairwise correlations among variables of interest for both borrowers and lenders. Spread is the difference between repo and FOMC midapoint rates. For any given participant, HHI denotes the Herfindahl-Hirschman Index of daily trading activity among their counterparties. Similarly, market share denotes the daily volume-weighted market share of their counterparties. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
Source: Federal Reserve Tri-Party Repo Collection, Authors' analysis.

Table VI: Rates Among Borrowers

	Dependent variable: log(repo rate)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Full Sample							
Number of Counterparties	0.00286			0.00458	0.00871**		0.0107**
	(0.00337)			(0.00382)	(0.00407)		(0.00445)
Borrowing Concentration		0.0448			0.102**	0.0369	0.105**
		(0.0355)			(0.0499)	(0.0367)	(0.0501)
Counterparties' Market Share			-0.0377*	-0.0430**		-0.0357	-0.0446**
			(0.0220)	(0.0214)		(0.0234)	(0.0211)
Observations	40,121	40,121	40,116	40,116	40,121	40,116	40,116
Number of Borrowers	41	41	41	41	41	41	41
R-squared	0.948	0.948	0.948	0.948	0.948	0.948	0.948
Panel B: Less Connected							
Number of Counterparties	-0.0106*			-0.00747	-0.00221		0.00130
	(0.00629)			(0.00742)	(0.00924)		(0.00935)
Borrowing Concentration		0.102*			0.0913	0.0887	0.0945
		(0.0577)			(0.0865)	(0.0615)	(0.0842)
Counterparties' Market Share			-0.0339	-0.0287		-0.0290	-0.0296
			(0.0222)	(0.0233)		(0.0235)	(0.0233)
Observations	21,196	21,196	21,191	21,191	21,196	21,191	21,191
Number of Borrowers	27	27	27	27	27	27	27
R-squared	0.944	0.944	0.944	0.944	0.944	0.945	0.945
Panel C: Well Connected							
Number of Counterparties	0.00537			0.00685	0.0111**		0.0135**
	(0.00447)			(0.00518)	(0.00470)		(0.00537)
Borrowing Concentration		0.0223			0.108*	0.0188	0.119**
		(0.0487)			(0.0631)	(0.0494)	(0.0576)
Counterparties' Market Share			-0.0367	-0.0596		-0.0353	-0.0733*
			(0.0481)	(0.0461)		(0.0520)	(0.0435)
Observations	18,925	18,925	18,925	18,925	18,925	18,925	18,925
Number of Borrowers	14	14	14	14	14	14	14
R-squared	0.953	0.953	0.953	0.953	0.953	0.953	0.954
Instrumental Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Intraday Timing	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Treasury Percentage	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Changes in Liquidity Needs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Fed Activity	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Policy Rate	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Fraction of Activity with Affiliated Counterparties	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Market Volume	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month-end FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter-end FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FOMC FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Borrower FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$. The sample includes observations (at the participant-day level) from September 8, 2015, to March 9, 2021. Borrowers that trade with less than 2 counterparties in the sample are not included in the analysis.
Source: Federal Reserve Tri-Party Repo Collection, BNYM Tri-Party Repo Settlement, Authors' analysis.

Table VII: Rates Among Lenders

	Dependent variable: log(repo rate)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Panel A: Full Sample						
Number of Counterparties	-0.00180			-0.00173	0.00523		0.00241
	(0.00897)			(0.00793)	(0.00920)		(0.00791)
Lending Concentration		0.0408			0.0555	0.0259	0.0327
		(0.0373)			(0.0339)	(0.0422)	(0.0439)
Counterparties' Market Share			0.218**	0.218**		0.218**	0.218**
			(0.104)	(0.104)		(0.105)	(0.105)
Observations	114,573	114,573	114,570	114,570	114,573	114,570	114,570
Number of Lenders	141	141	141	141	141	141	141
R-squared	0.722	0.722	0.727	0.727	0.722	0.727	0.727
	Panel B: Less Connected						
Number of Counterparties	0.0433			0.0395	0.0531		0.0383
	(0.0325)			(0.0279)	(0.0509)		(0.0575)
Lending Concentration		-0.0786			0.0240	-0.0769	-0.00284
		(0.0709)			(0.110)	(0.0754)	(0.159)
Counterparties' Market Share			0.344**	0.343**		0.343**	0.343**
			(0.143)	(0.142)		(0.142)	(0.142)
Observations	58,812	58,812	58,809	58,809	58,812	58,809	58,809
Number of Lenders	93	93	93	93	93	93	93
R-squared	0.607	0.607	0.619	0.619	0.607	0.619	0.619
	Panel C: Well Connected						
Number of Counterparties	-0.0209***			-0.0209***	-0.0114**		-0.0113**
	(0.00468)			(0.00467)	(0.00542)		(0.00539)
Lending Concentration		0.119***			0.0874***	0.120***	0.0882***
		(0.0245)			(0.0286)	(0.0249)	(0.0290)
Counterparties' Market Share			-0.00346	-0.00302		-0.00739	-0.00612
			(0.0222)	(0.0219)		(0.0195)	(0.0200)
Observations	55,761	55,761	55,761	55,761	55,761	55,761	55,761
Number of Lenders	48	48	48	48	48	48	48
R-squared	0.939	0.939	0.939	0.939	0.939	0.939	0.939
Instrumental Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Intraday Timing	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Treasury Percentage	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Changes in Liquidity Needs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Fed Activity	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Policy Rate	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Fraction of Activity with Affiliated Counterparties	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Market Volume	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month-end FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter-end FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FOMC FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lender FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$. The sample includes observations (at the participant-day level) from September 8, 2015, to March 9, 2021. Lenders that trade with less than 2 counterparties in the sample are not included in the analysis.
Source: Federal Reserve Tri-Party Repo Collection, BNYM Tri-Party Repo Settlement, Authors' analysis.

Table VIII: Haircuts Among Borrowers

	Dependent variable: log(average haircut)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Panel A: Full Sample						
Average Number of Counterparties	-0.00461			-0.00120	0.00634		0.00992
	(0.00631)			(0.00465)	(0.00645)		(0.00610)
Average Borrowing Concentration		0.139*			0.186*	0.117*	0.189**
		(0.0732)			(0.0917)	(0.0614)	(0.0897)
Average Counterparties' Market Share			0.0697*	0.0683*		0.0622**	0.0690**
			(0.0351)	(0.0346)		(0.0286)	(0.0305)
Observations	41	41	41	41	41	41	41
R-squared	0.612	0.648	0.663	0.664	0.654	0.692	0.706
	Panel B: Less Connected						
Average Number of Counterparties	-0.0182			-0.0114	-0.0175		-0.00638
	(0.0132)			(0.00831)	(0.0135)		(0.0120)
Average Borrowing Concentration		0.109			0.00587	0.0788	0.0421
		(0.0933)			(0.0820)	(0.0650)	(0.0945)
Average Counterparties' Market Share			0.0667*	0.0608*		0.0632*	0.0615*
			(0.0352)	(0.0323)		(0.0317)	(0.0334)
Observations	27	27	27	27	27	27	27
R-squared	0.862	0.857	0.896	0.903	0.862	0.903	0.904
	Panel C: Well Connected						
Average Number of Counterparties	0.00497			0.0113*	0.000901		0.00382
	(0.00505)			(0.00485)	(0.00263)		(0.00381)
Average Borrowing Concentration		-0.155***			-0.150***	-0.154***	-0.125**
		(0.0305)			(0.0353)	(0.0330)	(0.0342)
Average Counterparties' Market Share			0.0607	0.246*		0.0158	0.0866
			(0.0778)	(0.106)		(0.0504)	(0.0697)
Observations	14	14	14	14	14	14	14
R-squared	0.625	0.897	0.569	0.792	0.899	0.898	0.912
Controls for Intraday Timing	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Treasury Percentage	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Volume	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Fraction of Activity with Affiliated Counterparties	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Participation Rate	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$ and * $p < 0.1$. The sample contains one data point per participant. Such data points are averages across observations (at the participant-day level) from September 8, 2015, to March 9, 2021. Borrowers that trade with less than 2 counterparties in the sample are not included in the analysis.
Source: Federal Reserve Tri-Party Repo Collection, BNYM Tri-Party Repo Settlement, Authors' analysis.

Table IX: Haircuts Among Lenders

	Dependent variable: log(average haircut)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Panel A: Full Sample						
Average Number of Counterparties	0.114			0.106	0.139		0.130
	(0.111)			(0.110)	(0.148)		(0.146)
Average Lending Concentration		-0.503			0.193	-0.459	0.183
		(0.547)			(0.586)	(0.539)	(0.581)
Average Counterparties' Market Share			-0.139	-0.0930		-0.116	-0.0920
			(0.107)	(0.0962)		(0.101)	(0.0960)
Observations	141	141	141	141	141	141	141
R-squared	0.460	0.455	0.453	0.461	0.460	0.457	0.461
	Panel B: Less Connected						
Average Number of Counterparties	0.303			0.301	1.353		1.357
	(0.550)			(0.551)	(4.977)		(4.992)
Average Lending Concentration		-0.485			2.501	-0.478	2.515
		(0.726)			(10.73)	(0.725)	(10.77)
Average Counterparties' Market Share			-0.0771	-0.0747		-0.0752	-0.0763
			(0.112)	(0.115)		(0.113)	(0.119)
Observations	93	93	93	93	93	93	93
R-squared	0.470	0.469	0.468	0.471	0.473	0.469	0.473
	Panel C: Well Connected						
Average Number of Counterparties	0.0241**			0.0174*	-0.00246		-0.00384
	(0.0110)			(0.00898)	(0.0124)		(0.00935)
Average Lending Concentration		-0.212***			-0.226**	-0.162***	-0.184**
		(0.0732)			(0.101)	(0.0589)	(0.0774)
Average Counterparties' Market Share			-0.168**	-0.151**		-0.142**	-0.142**
			(0.0718)	(0.0665)		(0.0569)	(0.0568)
Observations	48	48	48	48	48	48	48
R-squared	0.236	0.332	0.425	0.502	0.333	0.564	0.565
Controls for Intraday Timing	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Treasury Percentage	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Volume	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Fraction of Activity with Affiliated Counterparties	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Participation Rate	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$. The sample contains one data point per participant. Such data points are averages across observations (at the participant-day level) from September 8, 2015, to March 9, 2021. Borrowers that trade with less than 2 counterparties in the sample are not included in the analysis.
Source: Federal Reserve Tri-Party Repo Collection, BNYM Tri-Party Repo Settlement, Authors' analysis.

Table X: Rates Among Borrowers in Periods of Stress

	Dependent variable: log(repo rate)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Panel A: Full Sample						
Interaction: Periods of Stress and # Counterparties	-3.52e-05			-0.00154	-0.00190		-0.00233
	(0.00132)			(0.00130)	(0.00230)		(0.00236)
Interaction: Periods of Stress and Borrowing Concentration		-0.00480			-0.0203	0.0140	-0.00518
		(0.0128)			(0.0221)	(0.0136)	(0.0244)
Interaction: Periods of Stress and Counterparties' Market Share			0.0385***	0.0426***		0.0411***	0.0405***
			(0.00910)	(0.00851)		(0.00973)	(0.00960)
Observations	40,121	40,121	40,116	40,116	40,121	40,116	40,116
Number of Borrowers	41	41	41	41	41	41	41
R-squared	0.948	0.948	0.948	0.948	0.948	0.948	0.949
	Panel B: Less Connected						
Interaction: Periods of Stress and # Counterparties	0.00203			-0.000152	-0.00289		-0.000260
	(0.00293)			(0.00272)	(0.00653)		(0.00688)
Interaction: Periods of Stress and Borrowing Concentration		-0.0242			-0.0401	-0.00153	-0.00312
		(0.0208)			(0.0443)	(0.0213)	(0.0525)
Interaction: Periods of Stress and Counterparties' Market Share			0.0445***	0.0425***		0.0424***	0.0426***
			(0.00863)	(0.00885)		(0.00935)	(0.0101)
Observations	21,196	21,196	21,191	21,191	21,196	21,191	21,191
Number of Borrowers	27	27	27	27	27	27	27
R-squared	0.945	0.945	0.945	0.945	0.945	0.945	0.945
	Panel C: Well Connected						
Interaction: Periods of Stress and # Counterparties	0.00128			-3.26e-05	-0.000704		-0.00165
	(0.000991)			(0.00126)	(0.00139)		(0.00146)
Interaction: Periods of Stress and Borrowing Concentration		-0.0711*			-0.0819*	-0.0520	-0.0609
		(0.0421)			(0.0479)	(0.0513)	(0.0526)
Interaction: Periods of Stress and Counterparties' Market Share			-0.0405	-0.0213		-0.0187	-0.0104
			(0.0281)	(0.0259)		(0.0190)	(0.0289)
Observations	18,925	18,925	18,925	18,925	18,925	18,925	18,925
Number of Borrowers	14	14	14	14	14	14	14
R-squared	0.953	0.953	0.953	0.953	0.954	0.953	0.954
Instrumental Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Intraday Timing	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Treasury Percentage	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Changes in Liquidity Needs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Fed Activity	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Policy Rate	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Fraction of Activity with Affiliated Counterparties	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Market Volume	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month-end FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter-end FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FOMC FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Borrower FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$. The sample includes observations (at the participant-day level) from September 8, 2015, to March 9, 2021. Borrowers that trade with less than 2 counterparties in the sample are not included in the analysis.
Source: Federal Reserve Tri-Party Repo Collection, BNYM Tri-Party Repo Settlement, Authors' analysis.

Table XI: Rates Among Lenders in Periods of Stress

	Dependent variable: log(repo rate)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Panel A: Full Sample						
Interaction: Periods of Stress and # Counterparties	-0.00498			-0.00220	-0.00550		-0.00381
	(0.00408)			(0.00250)	(0.00508)		(0.00575)
Interaction: Periods of Stress and Lending Concentration		0.0282			0.000857	0.00979	-0.00963
		(0.0276)			(0.0479)	(0.0177)	(0.0440)
Interaction: Periods of Stress and Counterparties' Market Share			-0.0691	-0.0660		-0.0656	-0.0656
			(0.0777)	(0.0788)		(0.0773)	(0.0775)
Observations	114,573	114,573	114,570	114,570	114,573	114,570	114,570
Number of Lenders	141	141	141	141	141	141	141
R-squared	0.723	0.723	0.727	0.727	0.723	0.727	0.727
	Panel B: Less Connected						
Interaction: Periods of Stress and # Counterparties	-0.0362			-0.0420	-0.0648		-0.163*
	(0.0328)			(0.0400)	(0.0591)		(0.0984)
Interaction: Periods of Stress and Lending Concentration		0.0727			-0.0653	0.0625	-0.273
		(0.0740)			(0.142)	(0.0818)	(0.194)
Interaction: Periods of Stress and Counterparties' Market Share			-0.0901	-0.0859		-0.0878	-0.0865
			(0.114)	(0.109)		(0.110)	(0.109)
Observations	58,812	58,812	58,809	58,809	58,812	58,809	58,809
Number of Lenders	93	93	93	93	93	93	93
R-squared	0.608	0.608	0.620	0.620	0.608	0.620	0.620
	Panel C: Well Connected						
Interaction: Periods of Stress and # Counterparties	0.00637***			0.00581***	-0.00313		-0.00341
	(0.00156)			(0.00142)	(0.00320)		(0.00322)
Interaction: Periods of Stress and Lending Concentration		-0.0528***			-0.0842***	-0.0483***	-0.0814***
		(0.0131)			(0.0255)	(0.0122)	(0.0256)
Interaction: Periods of Stress and Counterparties' Market Share			0.0246**	0.0220**		0.0212*	0.0216*
			(0.0110)	(0.0108)		(0.0119)	(0.0115)
Observations	55,761	55,761	55,761	55,761	55,761	55,761	55,761
Number of Lenders	48	48	48	48	48	48	48
R-squared	0.939	0.939	0.939	0.939	0.940	0.940	0.940
Instrumental Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Intraday Timing	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Treasury Percentage	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Changes in Liquidity Needs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Fed Activity	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Policy Rate	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Fraction of Activity with Affiliated Counterparties	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Market Volume	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month-end FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter-end FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FOMC FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lender FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.The sample includes observations (at the participant-day level) from September 8, 2015, to March 9, 2021. Lenders that trade with less than 2 counterparties in the sample are not included in the analysis.
Source: Federal Reserve Tri-Party Repo Collection, BNYM Tri-Party Repo Settlement, Authors' analysis.

Online Appendix for "Treasury Tri-Party Repo Pricing"

This online appendix contains material to supplement the analysis in "Treasury Tri-Party Repo Pricing." Appendix A contains information on how we clean our data. Appendix B provides stylized facts about the overall overnight tri-party repo market.

Appendix A Cleaning the Data

Our sample consists of all tri-party repo transactions reported by the Bank of New York Mellon (BYNM) from September 2015 through March 2021. In the data, observations describe the flow of cash and collateral between the BYNM accounts of participants. These observations include information about interest rates, trade and maturity dates, and timestamps indicating when participants informed BYNM about their trade. Because participants can have several accounts with BYNM and a single transaction might involve cash/collateral being drawn from various accounts, a single transaction might be represented by several observations in the sample.

We restrict our analysis to observations referring to fixed overnight transactions and "open" transactions for which pricing resets daily (making such transactions economically similar to overnight transactions). This follows the standard methodology used by the New York Fed in its calculation of the Secured Overnight Financing Rate. As tri-party is general collateral (that is, multiple types of collateral may underlie the same repo agreement) and we cannot observe the prearranged set of acceptable collateral between counterparties, we use the collateral assigned by the BNYM settlement process. Using BNYM's collateral classification, we split repo agreement volume into the three major collateral classes: Treasuries, agencies, and other. Here are the steps we use to determine which observations refer to overnight transactions and their characteristics:

- Overnight transactions are determined by (a) looking at the difference between the start and end dates, such that the number of business days equals one (to account for holidays and weekends), or (b) using transactions where the open flag is true. All the transactions considered are negotiated daily, rather than being structured to follow a predetermined reference rate.

- We remove dates that are official holidays or dates that resemble holiday activity (i.e. when gross overnight activity is less than $300 billion).

- An observation's timestamp is determined as the minimum of the timestamps reported by either the lender or the borrower. As larger money market complexes wait to split single transaction volume across multiple lender accounts after money market account withdrawals are close (1 PM), we do not use these volumes when assessing transaction timestamps.

- We also remove transactions involving accounts used for testing BNYM services.

To uncover transactions from observations, we group observations based on (i) the identity of lenders and borrowers and (ii) timestamps. If two observations share the same lender and borrower and have similar timestamps, we assume these observations are part of the same transaction.

To uncover the identity of participants from accounts, we use the following two-step procedure:

- We first separate accounts based on lending/borrowing activity. In practice, the majority of accounts are either used for lending or borrowing purposes (but not both). Our initial sample contains $8,012$ accounts, with $7,859$ accounts associated with lending activity and 153 accounts associated borrowing activity.

- After separating accounts based on lending/borrowing activity, we use a double sorting procedure that considers information from string-matching and account usage.

  - *String-matching*: First, we sort accounts based on the name of their parent institution. Here, we start with groups defined by the New York Fed. There are 148 such groups. Unfortunately, this classification is sometimes imprecise. For example, there are 1,087 accounts classified within the *account name group* "Other." To improve the precision of our method, we use string matching on top of the New York Fed classification. That leads to 729 participants, accounting for 659 lenders and 79 borrowers.

  - *Account usage*: Because two accounts might share the same parent institution's name but be managed by different decision-makers (e.g., trading desks), we use account usage as a second sorting dimension to further improve our classification. The idea is simple. If two accounts are frequently mentioned together in similar observations, it is likely they are being managed by the same decision-maker. Hence, these accounts should share the same participant ID. To implement this idea, we form all possible pairs of accounts between lenders and borrowers and then count how often any given pair is mentioned in similar observations. To

uncover groups of accounts, we represent our data as a graph. Each node represents an account. A link between node i and j means that there is one observation in which accounts i and j are likely to have jointly participated. Within this setting, uncovering decision-makers is equivalent to uncovering clusters of nodes in the graph; here, all nodes in a cluster are considered to be a single participant (decision-maker). We use the Louvain community detection algorithm to uncover clusters; see Blondel et al. (2008). That leads to 252 lenders and 18 borrowers.[21]

- Double sorting accounts by string-matching and account usage yields 962 different participants, accounting for 84 borrowers and 878 lenders.

After double sorting, we restrict attention to accounts that are only mentioned in observations related to overnight transactions. That reduces our number of participants to 587, accounting for 75 borrowers and 512 lenders. These participants, in turn, represent 348 different institutions at the parent company level.

Finally, we remove participants whose accounts are rarely used or trade small amounts. In terms of account usage, participants in the smallest 1% of the distribution are mentioned fewer than two times in the sample. In terms of average trading volume per account, the smallest 1% is $500,000. We remove participants that belong to the 1 percentile of both distributions, which yields 466 participants, accounting for 75 borrowers and 466 lenders (representing 3,399 accounts). These participants, in turn, represent 319 different institutions at the parent company level.[22]

Appendix B Stylized Facts

This section presents several stylized facts of the overnight tri-party repo market.

A Relevance of overnight tri-party repos and rate-haircut dynamics

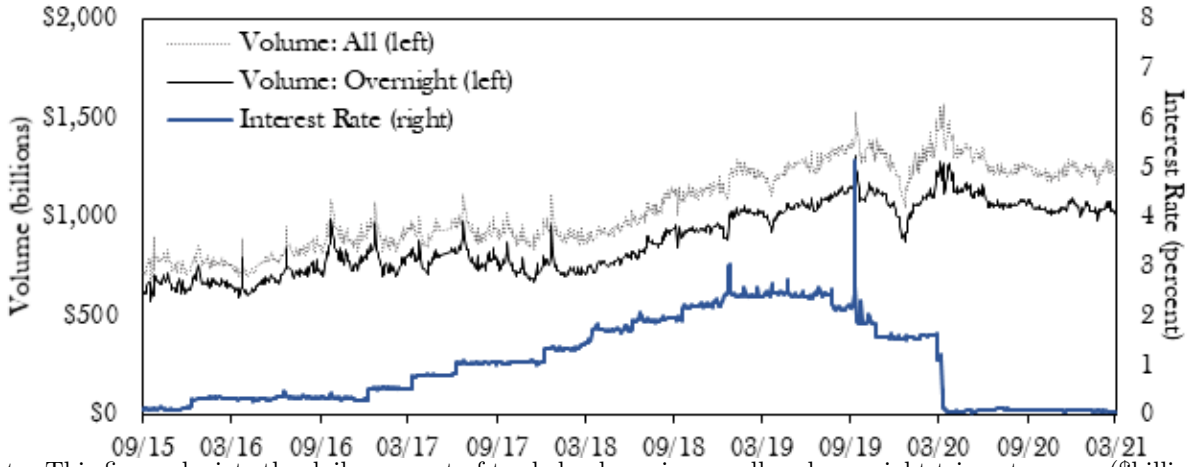
Figure B.1 highlights that the largest portion of the U.S. tri-party repo market across all collateral classes is represented by its overnight segment. Although average rates remain relatively stable day-to-day, volumes have exhibited large spikes and steady growth since 2018, with the noticeable exception of early 2020 due to an increase in the usage of repos with maturities longer than overnight.

[21] Here, we do not consider link weights to compute clusters.

[22] If we were to remove accounts below the 5% usage and trading volume, we would have 562 participants: 75 borrowers and 487 lenders. If we were to use only string-matching, we would have 374 participants: 65 borrowers and 309 lenders.

For a better sense of the dynamics of the effective haircut the average borrower faces in tri-party, Figure B.2 depicts the daily (dollar-weighted) average haircut associated with repos collateralized with either Treasuries or agency securities. As repos resemble a collateralized loan, the perceived credit quality and liquidity of collateral can alter haircuts. Consistent with this idea, Figure B.2 shows that the average borrower effectively faces considerably lower haircuts when posting Treasuries as collateral than when posting agencies.[23]

Figure B.1. Daily Volume and Average Rate



Note: This figure depicts the daily amount of traded volume in overall and overnight tri-party repos ($billions) and the average dollar-weighted interest rate (percent) in the overnight tri-party repo market.
Source: Federal Reserve Tri-Party Repo Collection, Authors' analysis.

B Market participants

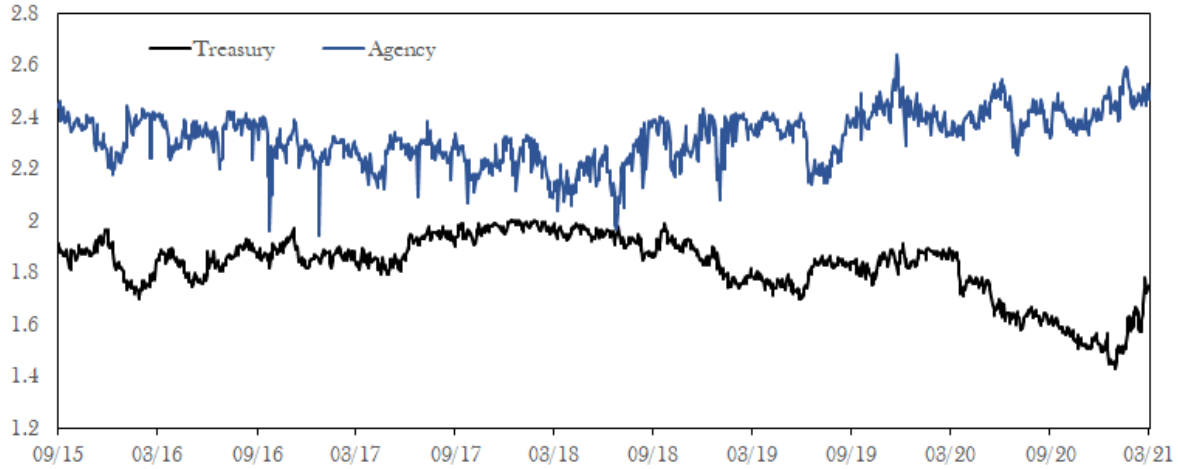
Within the overnight tri-party segment, most lenders seek interest income at very short maturities and/or a secured alternative to bank deposits for their balances that exceed the deposit insurance cap. Most borrowers—many of whom tend to be large high-credit-quality institutions—use tri-party repos to obtain large amounts of short-term financing at low cost for their securities inventories and their lending to clients.

Figures B.3 and B.4 help illustrate an important observation. While most borrowers frequently participate in both Treasury and agency repos, several lenders only participate in Treasury repos. On an average day, around 110 lenders and 30 borrowers participate in repos, while around 70 lenders and 30 borrowers participate in agency repos.

A direct consequence of the difference in numbers between lenders and borrowers is that, on any given day, the average borrower interacts with more counterparties than the average

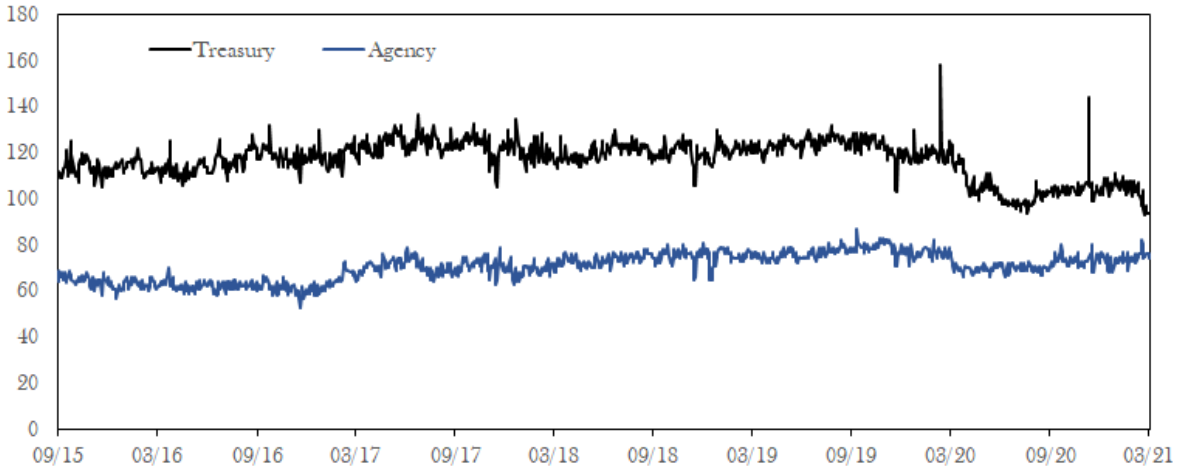
[23] Although, at the transaction level, treasuries tend to command a 2% haircut among non-affiliated counterparties, the existence of affiliated counterparties—wherein haircuts can be considerably lower—helps explain that the average borrower using treasuries as collateral effectively faces a haircut lower than 2%.

Figure B.2. Daily Average Haircuts



Note: This figure depicts the daily (dollar-weighted) average haircut (percent) in the overnight tri-party repo market separated by collateral class.
Source: Federal Reserve Tri-Party Repo Collection, Authors' analysis.

Figure B.3. Number of Lenders



Note: This figure depicts the number of lenders that participate in the overnight tri-party repo market separated by collateral class.
Source: Federal Reserve Tri-Party Repo Collection, Authors' analysis.

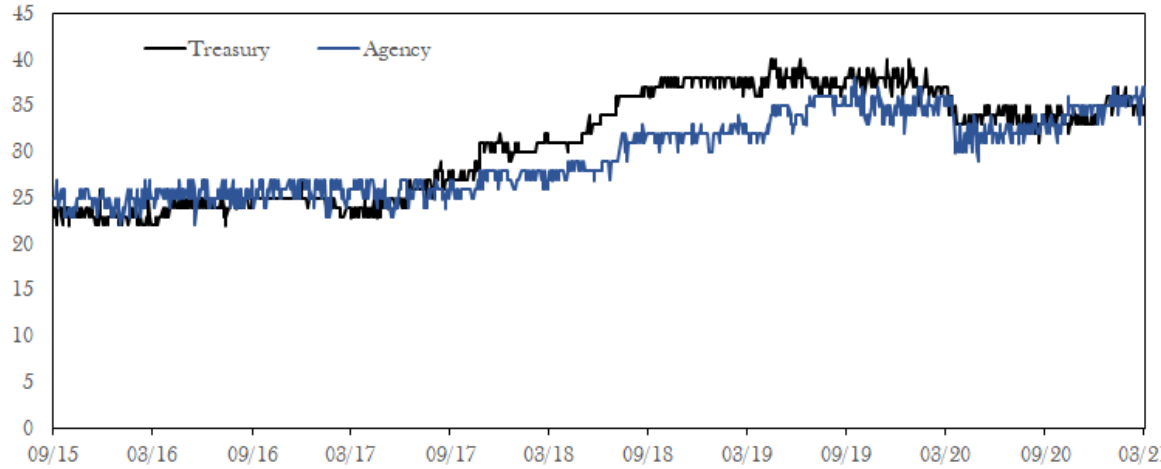
lender. Aside from illustrating this point, Figures B.5 and B.6 show that collateral also plays a role in the number of counterparties of the average market participant.

C Intraday Dynamics

C.1 Trading

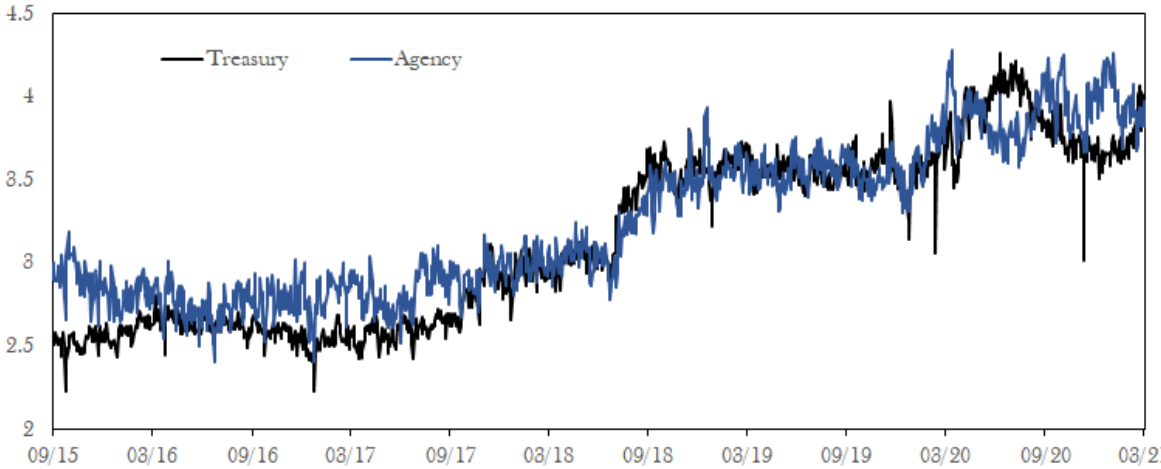
Because of the large quantity of funding that overnight tri-party repos provide to the U.S. financial system, it is important to understand the daily clearing cycle of this segment—that is,

Figure B.4. Number of Borrowers



Note: This figure depicts the number of borrowers that participate in the overnight tri-party repo market separated by collateral class.
Source: Federal Reserve Tri-Party Repo Collection, Authors' analysis.

Figure B.5. Number of Borrowers Trading with the Average Lender

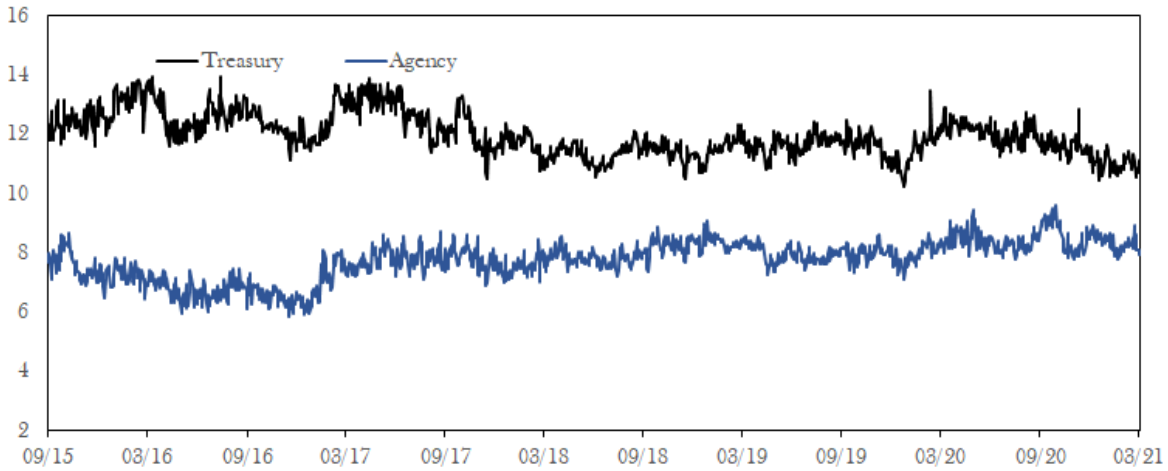


Note: This figure depicts the number of borrowers of the average lender per day in overnight tri-party repos separated by collateral class.
Source: Federal Reserve Tri-Party Repo Collection, Authors' analysis.

the process through which lenders and borrowers trade with one another. Figure C.1 presents two views of the intraday clearing cycle.[24] Figure C.1a shows how lending is distributed

[24]Although we observe the time stamps of all transactions, we have reason to believe that certain transactions do not necessarily report the precise time at which a lender and borrower agreed on a repo. While most participants follow market best practices and submit the terms of their repos to BNYM shortly after trading, certain types of trades submit later. For example, consider the trades of a large lender that manages several accounts with BNYM. It is not uncommon for these lenders to agree to a single large repo transaction early in the day. However, to allow themselves time to allocate these agreements across accounts with available cash, these transactions are submitted to BNYM typically after noon but before the 3:30 PM unwind. To overcome this issue, we redistribute the volume associated with each of these trades according to

Figure B.6. Number of Lenders Trading with the Average Borrower



Note: This figure depicts the number of lenders of the average borrower per day in overnight tri-party repos separated by collateral class.
Source: Federal Reserve Tri-Party Repo Collection, Authors' analysis.

during the course of the day, where "6 AM ≥" represents the early morning activity as well as trades negotiated days prior. This figure highlights activities peaking at 8 AM and slowly declining until 1 PM. Figure C.1b shows a different view of the intraday clearing cycle by presenting the average portion of the market cleared throughout the day. This figure highlights a somewhat persistent clearing process, with trades typically taking place between 8 and 9 AM, with a modest late day spike around 1 PM. In contrast to centrally cleared DVP and GCF, discussed in Chow et al. (2021), Copeland et al. (2025), and Anbil et al. (2021), we find that the overnight tri-party repo market clears slightly later in the day, in part because of Federal Reserve operations and settlement timing differences.

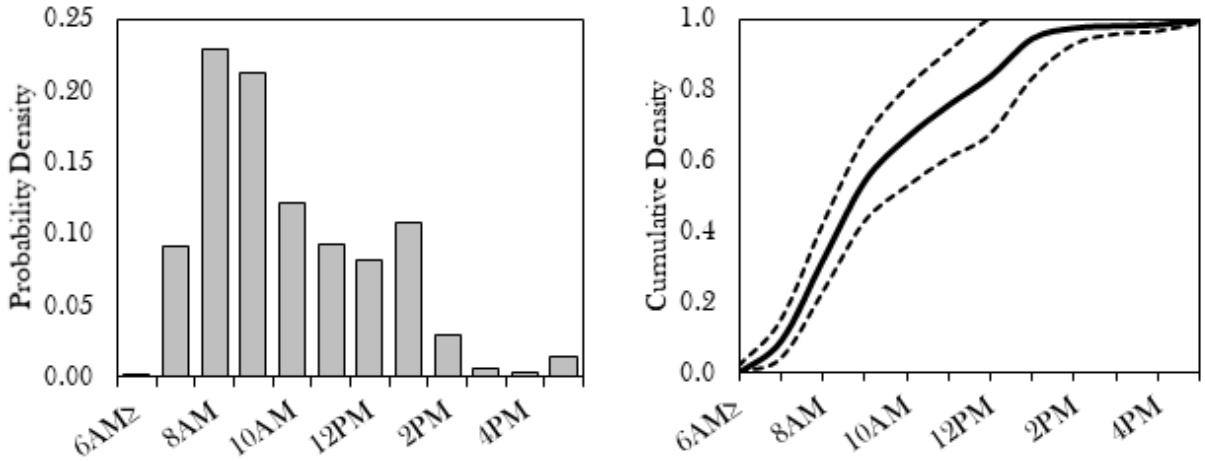
C.2 Market Participation

Figure C.2 underscores that the composition of market participants varies over the course of the day. Figures C.2a and C.2b depict the hourly volumes (in billions of dollars) of activity by participant type. Figure C.2a highlights the importance of asset managers as lenders, while Figure C.2b emphasizes the importance of primary dealers as borrowers. Interestingly, among lenders, government-sponsored enterprises (GSEs) and securities lenders tend to participate in the first half of the day, while commercial banks make up most of the late-day trades. Among borrowers, non-primary dealers participate only in the first half of the day, while the Federal Reserve's reverse repo facility has historically made up a large portion of the activity

the empirical intraday distribution of transactions in which we believe time-stamps are properly reported to BNYM.

Figure C.1. Intraday Clearing

(a) PDF **(b)** CDF

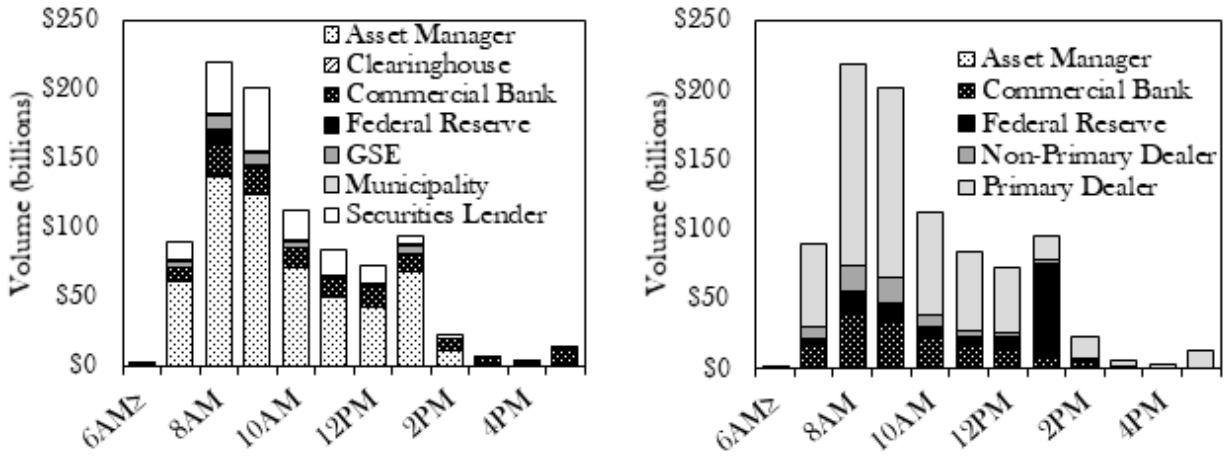


Note: This figure shows that the overnight segment of the U.S. tri-party repo market has a persistent daily clearing cycle. Plot (a) presents the probability density function of funding at each hour of the day, where "6 AM ≥" represents the early morning activity as well as overnight lending negotiated days prior. Plot (b) presents the mean (+/- 2 standard deviation bands) of the cumulative density function of funding at each hour of the day.
Source: Federal Reserve Tri-Party Repo Collection, Authors' analysis.

during the second half of the day (mostly at 1 PM).

Figure C.2. Intraday Participation

(a) Lenders **(b)** Borrowers



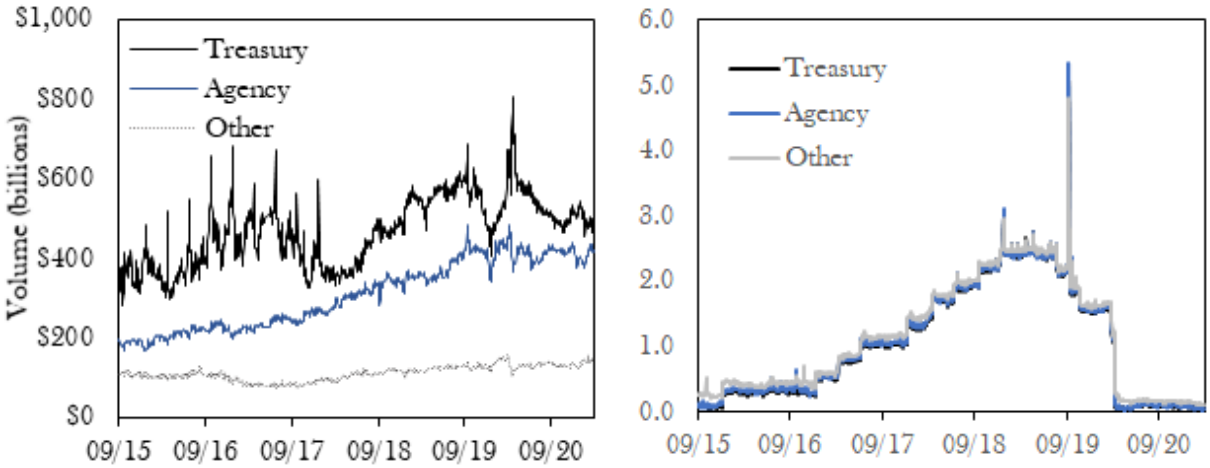
Note: This figure shows that there is heterogeneity among market participants about the time they choose to arrange their overnight tri-party repos. This figure presents the hourly volumes of different types of lenders and borrowers. In each plot, legends identify bars in order from bottom to top.
Source: Federal Reserve Tri-Party Repo Collection, Authors' analysis.

D Collateral

Although different types of securities can be used as collateral in tri-party repos, most overnight transactions are collateralized with either U.S. Treasuries and/or agency securities. For ease of exposition, we classify collateral into three major types: (1) U.S. Treasury securities, referring to U.S. Treasury bills, notes, and bonds; (2) U.S. agency securities, referring to mortgage-backed securities, as well as debt issued by U.S. government agencies and GSEs; and (3) other, referring to the remaining mix of collateral, which includes securities such as corporate bonds, non-U.S. sovereign debt, equity, municipal debt, and commercial paper. Figures D.1a and D.1b depict volumes (in billions of dollars) and rates (percent) separated by different collateral types. Figure D.1a shows that overnight funding has steadily been increasing mainly for Treasury and agency securities, with Treasury securities accounting for most of the collateral used in overnight repos. Figure D.1b shows that weighted average interest rates move in relative lockstep. Average interest rates across collateral classes are generally steady, with occasional spikes, as highlighted by the events of September 2019; see Schulhofer-Wohl (2019), Afonso et al. (2021), Copeland et al. (2025), and Anbil et al. (2021).

Figure D.1. Daily Volumes and Rates by Collateral Groups

(a) Trading volume **(b)** Average rate



Note: This figure depicts volumes and rates by collateral type. Plot (a) shows that overnight funding has steadily been increasing, with Treasury and agency securities comprising most transactions. Plot (b) shows that the weighted average interest rate (by collateral classes) moves in relative lockstep.
Source: Federal Reserve Tri-Party Repo Collection, Authors' analysis.