

Negative Rates in Bilateral Repo Markets

by Samuel J. Hempel and R. Jay Kahn¹

We examine the determinants of recent negative rates in bilateral repo markets. These negative rates stemmed from two sources: (1) broad factors that pushed down general collateral repo rates, and (2) narrower factors that pushed bilateral repo rates below comparable tri-party general collateral rates. We discuss both sources of negative repo rates. We show that much of the spreads between cleared bilateral and tri-party repo rates is explained by demand for special collateral, which made up a sizable portion of bilateral repo in recent months. Finally, we examine the effect of these special collateral transactions on the Secured Overnight Financing Rate (SOFR) and find that the existing construction of the SOFR successfully limits the impact of specials on the reference rate.

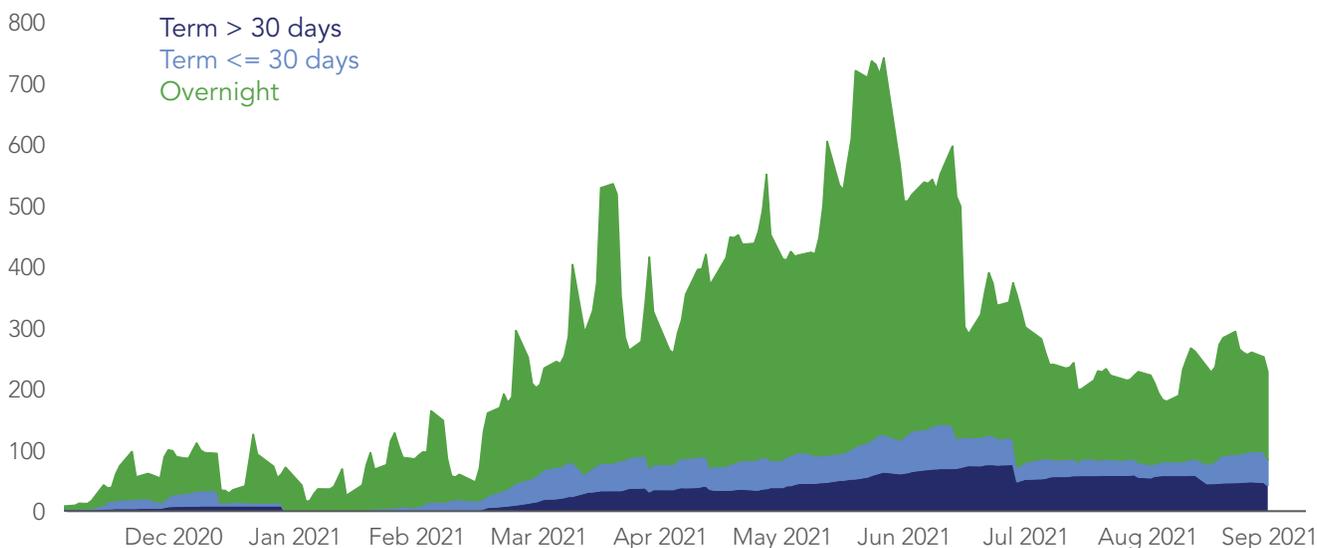
1. Introduction

Between January 1, 2021 and September 1, 2021, there were 69 days where the average overnight repo rate in the cleared bilateral repurchase agreements (repo) market was below zero.² For much of May 2021, daily volumes in the cleared bilateral market at negative rates exceeded \$500 billion, or 46% of all outstanding volume in cleared bilateral repo, and reached a maximum of over \$700 billion in late May (see **Figure 1**). Interest rates on repo are crucial indicators of funding conditions in financial markets. Repo markets represent a significant source of funding for a broad variety of financial actors and a key method of sourcing securities. They also underlie important reference rates, such as the SOFR.³ As a result, the determinants of

negative repo rates are important to understand for a variety of participants across the financial system.

In this brief, we examine the sources of negative repo rates. We focus on the bilateral market because, while there were some negative rates during this period in other markets, negative rates were concentrated in cleared bilateral markets. Negative rates in cleared bilateral markets were a product of low general collateral rates as well as spreads between tri-party rates and cleared bilateral rates. In early 2021, rates in tri-party markets were driven to near-zero by a number of factors, including changes in the supply of reserves to banks and the availability of alternative investments to repo in the form of bills. When tri-party general collateral rates are near zero, even small premia for transactions in cleared bilateral repo can lead to negative rates. In bilateral

Figure 1. Outstanding Volumes in DVP at Negative Rates by Term (\$ billions)



Note: Volumes are for all DVP repo occurring at negative rates.

Sources: OFR Cleared Repo Collection, Office of Financial Research

markets, lenders may be willing to receive lower rates than in tri-party repo markets for two primary reasons:

1. Lending in bilateral markets that feature specific-security settlement is a convenient way to source securities; for securities that are in particular demand, lenders may be willing to pay a premium to access that collateral.
2. Participants in cleared bilateral markets differ from those in other repo markets, and those in uncleared bilateral markets may have different outside options.

In the presence of low general collateral rates, explaining negative rates in bilateral repo markets, therefore, means explaining how these two factors drive the lower tail of rates in bilateral repo.

Our results show that the deepest negative rates in spring 2021 were likely associated with specific collateral demand. This is consistent with previous episodes of negative rates, as discussed in Fleming and Garbade (2004).⁴ We show that the most extreme rates have often been associated with on-the-run Treasuries around reopenings.⁵ However, more than half of negative-rate activity in cleared bilateral repo markets occurred in off-the-run Treasuries. For off-the-run Treasuries, it is more difficult to determine the extent to which premia

are the result of specific collateral demand, since rates can also be driven by factors such as the counterparties involved or the time of day in which a transaction occurs. We construct a filter for specialness by identifying Treasuries at the level of the individual security used as collateral in cleared bilateral repo that are also borrowed on the same day from the Federal Reserve's Securities Open Market Account (SOMA) securities lending operations.⁶ These operations provide an alternative venue for sourcing collateral. Our filter captures much of the negative rate activity during 2021, confirming the role of special collateral in driving negative rates.

One reason it is important understand negative-rate repo activity is because of the potential effect these rates might have on the calculation of the SOFR. We show this impact has been limited by the construction of the SOFR. Reference rates such as the Tri-Party General Collateral Rate (TGCR) and Broad General Collateral Rate (BGCR) only reflect tri-party, general collateral repo markets in which we have seen little negative-rate activity.⁷ However, the SOFR includes certain transactions from cleared bilateral markets, meaning it is not a purely general collateral rate. These transactions serve to increase the volumes underlying the SOFR, as argued in Bowman et al. (2017).⁸ However, it has generally been thought of as desirable to limit the effect of special

collateral rates on the SOFR, since these rates may be exposed to issues specific to the Treasury market but uncorrelated with general costs of overnight funding. Our results confirm that these limits are important. We show that deep specials rates can occur around Treasury reopenings with significant volumes. Since these reopenings are unlikely to affect funding costs for agents with low exposure to Treasury auctions, it is prudent to exclude these specials from the pool of transactions used to calculate the SOFR. We show that the existing filters that the SOFR employs, based on cutting out the bottom 25th percentile of rates from cleared bilateral repo, have performed this role well during 2021.

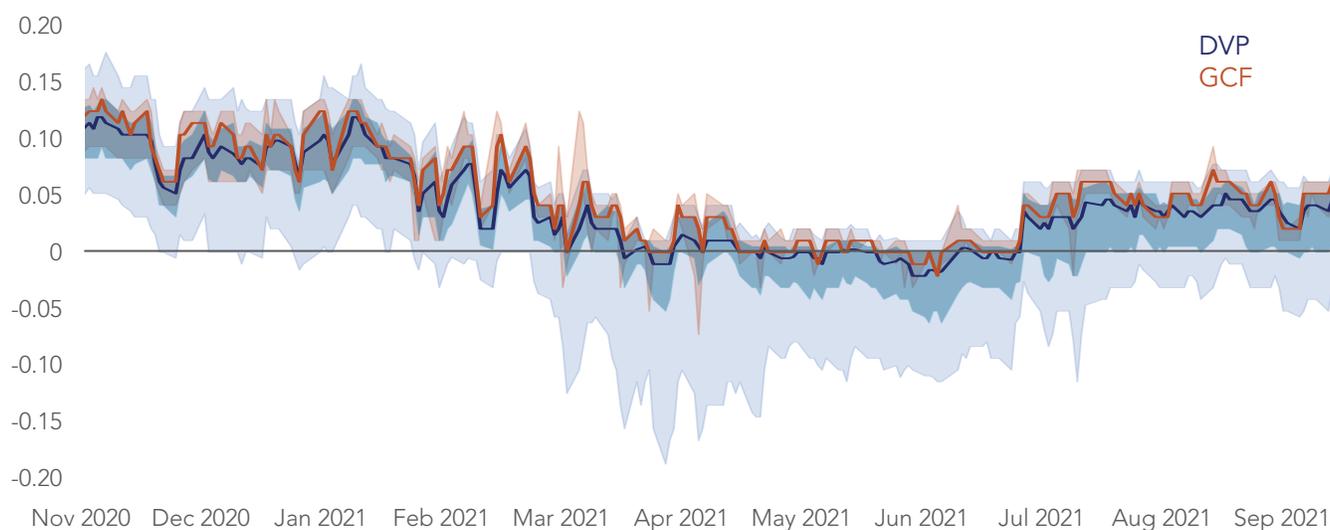
Our results also clarify the important role that the Federal Reserve’s Overnight Reverse Repurchase (ON-RRP) facility has played in repo markets. The ON-RRP facility is designed to keep the federal funds rate above the lower bound on the federal funds target range by providing a floor on funding rates. Our brief suggests this facility has been effective for eligible counterparties in two ways. First, despite the prevalence of negative rates in DVP, money market funds continued to lend at positive repo rates throughout 2021. To the extent that other counterparties of the ON-RRP facility have lent at negative rates, these rates are likely explained by factors specific to the cleared bilateral

repo market such as specific security demand, netting benefits from clearing, and the timing of transactions. Second, technical adjustments that have increased the ON-RRP facility rate have been met by consummate increases in the rates money market funds receive as well as similar increases across the distribution of bilateral repo rates. In particular, the technical adjustment to the ON-RRP facility that took effect on June 17 and raised the ON-RRP rate from zero to five basis points was associated with a decrease in overnight volumes at negative rates of almost \$200 billion.

2. Negative Rates in Bilateral Repo Markets

We begin by examining the distribution of repo rates across repo markets. **Figure 2** shows percentiles of overnight repo rates for Treasury collateral in the cleared bilateral market, represented by the Fixed Income Clearing Corporation’s DVP Service (DVP), and percentiles of rates in the cleared tri-party market, represented by the Fixed Income Clearing Corporation’s GCF Service (GCF). As can be seen, beginning in early 2021, rates in both DVP and GCF began to decline, with DVP rates generally falling below GCF rates. As a result of both the general decline in rates and the greater spread in DVP rates, for much of 2021 the 10th

Figure 2. Distribution of Overnight Treasury Repo Rates in DVP and GCF (percent)



Note: For blue areas, lightly shaded areas denote the 10th to 90th volume-weighted percentiles of overnight Treasury DVP repo rates, the darker shaded area denotes the 25th to 75th weighted percentiles, and the line denotes the weighted median. For orange areas, lightly shaded areas denote the 10th to 90th weighted percentiles of GCF rates and the line denotes the weighted median.

Sources: OFR Cleared Repo Collection, Office of Financial Research

and 25th percentiles of rates were below zero. In several periods, even the median rate in DVP was negative. Over the same period, GCF rates generally – although not always – remained positive. The extent of this negative-rate activity then decreased greatly after the rate on the ON-RRP facility was raised by 5 basis points in June.

The greater prevalence of negative rates in DVP versus GCF provides an important launching point for our analysis. The transactions underlying both distributions share several attributes: they are both cleared by the same central counterparty, they both are collateralized by Treasuries, and they both have the same tenor. However, there are differences between these transactions because of how the two markets they take place in are organized. First, while GCF is a general collateral market, DVP is a specific collateral market. Rates in DVP can, therefore, reflect a premium for valuable collateral known as a special collateral rate, explained in more detail below. This ability to source collateral is one major advantage of DVP over GCF and may drive

a significant portion of DVP volumes. Second, DVP involves a broader set of counterparties than GCF, including money market funds and hedge funds. The outside options for investment of these different groups differ, as do rates. For instance, most money market funds have access to the ON-RRP facility, which has given those funds the opportunity to lend at rates at or above zero throughout 2021. Hedge funds, conversely, do not have access to this facility.

We can, therefore, think of the prevalence of negative rates in bilateral repo markets as a mix of two driving forces: (1) a broad decline in general collateral rates, and (2) a widening of spreads of DVP rates over general collateral rates. **Figure 3** examines both of these factors and shows how they both contributed to negative rates in DVP. From January to March 2021, rates in GCF fell by 6 basis points. Over the same period, the spread of the 10th percentile of DVP rates over the median GCF rate fell by an additional 6 basis points. Even without a decline in GCF rates over this period, the 10th percentile of DVP rates would have been negative.

Figure 3. Median GCF Rate and Spread of DVP Rate Percentiles Over Median GCF Rate (basis points)

Month (2021)	Median Rate GCF	DVP Percentile Spread Over GFC Median				
		10	25	50	75	90
January	8.26	-7.50	-3.16	-0.83	0.62	3.03
February	5.95	-8.58	-3.55	-1.55	0.00	1.76
March	2.39	-13.80	-3.59	-1.41	0.02	1.07
April	0.67	-11.07	-3.03	-0.64	0.26	1.42
May	0.00	-9.88	-3.83	-0.72	0.38	1.36
June	1.95	-9.27	-4.14	-0.80	0.44	1.82
July	5.83	-10.08	-5.92	-1.79	-0.25	1.00

Note: Rates are monthly averages of different percentiles across the daily distribution of overnight Treasury rates in DVP and GCF for each month of 2021. Sources: OFR Cleared Repo Collection, Office of Financial Research

With the decline in GCF rates, however, both the 10th and 25th percentiles turned negative.

3. Low General Collateral Rates

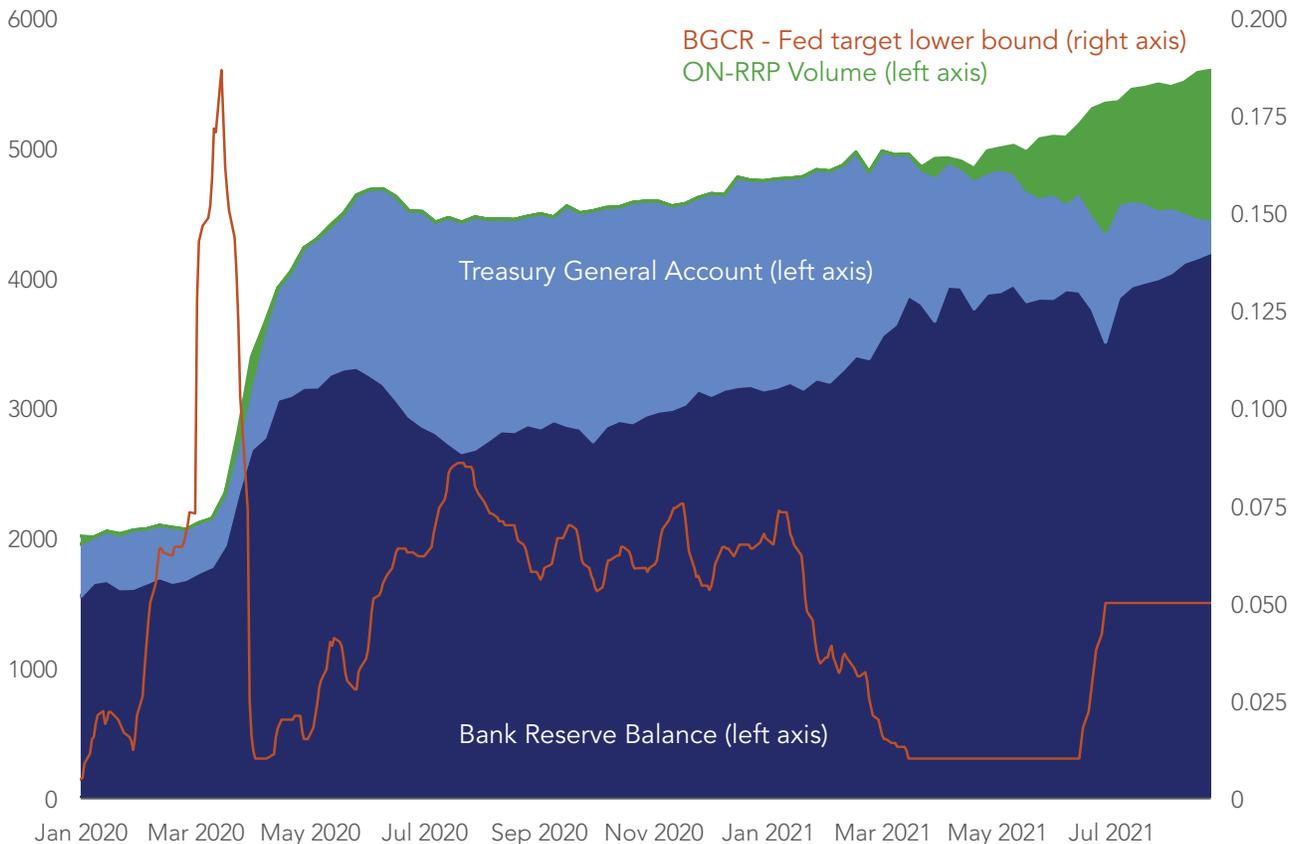
We begin by examining the drivers of low general collateral rates. Several factors may have influenced the decline in general collateral repo rates in early 2021. **Figure 4** shows the Broad General Collateral Rate (BGCR), which is based on transactions in GCF as well as the uncleared tri-party market for which Bank of New York Mellon serves as the custodian, along with several of these contributing factors.

1. Increase in reserves: Following disruptions in financial markets in March of 2020 associated with the COVID-19 pandemic, the Federal Reserve began a large and ongoing expansion of reserves as part of its efforts to support the economy. All else being equal, higher levels of reserves with banks reduce the repo rate in concert with an increased

supply of cash that is available for lending into the repo market.

- 2. Decrease in the Treasury General Account (TGA):** As uncertainty with regards to pandemic-related federal government spending was resolved in early 2021, the Treasury began to withdraw funds from the TGA, a cash account the Treasury keeps with the Federal Reserve. This cash account had been built up to unprecedented levels since April 2020 to support potential fiscal relief. All else being equal, a decrease in the TGA increases reserves with banks, which in turn should decrease repo rates.⁹
- 3. Decrease in bills issuance:** Relatedly, issuance of Treasury bills, which had been high since April, began to decrease as the Treasury drew down on its cash account to meet funding needs instead of funding with new bill issuance. Bills provide a close substitute to repo, and lower bill issuance tends to

Figure 4. Reserve Balances and Repo Rates (billions, percent)



Note: The BGCR-IOER lower bound spread is a monthly rolling average.

Sources: OFR Cleared Repo Collection, Factors Affecting Reserves Release, Federal Reserve Bank of New York Press Releases, Office of Financial Research

drive down bill yields, leading to lower repo rates as money market funds shift from bills to repo.

- 4. Other factors:** There have been some reports that the expiration of the exemption of Treasuries from the Supplementary Leverage Ratio (SLR) may have led to banks encouraging depositors to invest in money market funds, which would again cause a decrease in repo rates.¹⁰

Among these different drivers of lower repo rates, it is difficult to disentangle exactly which was most important, especially since many of them have common causes and few are mutually exclusive.

Regardless of which factor was most important, the combination of factors drove the general collateral repo rate towards the bottom of the federal funds target range by February 2021. Near the bottom of this range, the general collateral repo rate is determined largely by the ON-RRP facility. This facility was introduced to provide a firm floor to the federal funds range.¹¹ It offers an outside option for safe overnight investments to a broad set of counterparties. Eligible counterparties — largely money market funds, though also including primary dealers, banks, and government-sponsored enterprises — are permitted through this facility to lend in overnight repo to the Federal Reserve at an interest rate generally set near the lower bound on the Federal Funds range.¹²

When the rates offered by banks, or other borrowers, are below this range, ON-RRP counterparties may instead choose to increase their investments in the ON-RRP facility. This ultimately reduces the supply of wholesale funding to banks whenever their required rate of return is below the ON-RRP facility rate, requiring a corresponding reduction in their holdings of reserves funded through wholesale markets. As rates declined in the repo market, participation in the ON-RRP facility began to rise, increasing from no volume to around \$500 billion per day in May. The increase in the rate offered by the ON-RRP facility on June 17 by 5 basis points increased the value of this outside option, increasing facility volumes by \$235 billion on the first day. This action raised general collateral rates one-for-one with the increase in the facility, and the BGCR remained at 5 basis points through the end of August.

4. Collateral Demand and Negative Rates

The decrease in general collateral rates in early 2021 led to negative rates in the cleared bilateral repo market in part because many DVP trades occurred at rates below general collateral rates. One reason that some rates in DVP may fall below rates in GCF is due to the specific-security nature of settlement. DVP repo allows for lenders to demand a specific CUSIP be delivered as collateral. This ability to demand specific collateral is useful for two purposes. First, if the repo lender expects a particular security to depreciate, specific collateral repo allows the lender to short that security by lending against it as collateral. The lender can borrow the security from a repo borrower and then sell that security in the cash market. When the repo loan comes due, the lender expects to repurchase the security in the cash market for a lower price and deliver it to the borrower in exchange for their cash.¹³ Second, if cash markets are relatively illiquid and the lender has a client who wishes to buy a specific security, specific collateral repo can allow them to temporarily source that security from a borrower.

Market participants and economists thus often distinguish between “general collateral” transactions, which involves rates which in principle reflect purely costs of funding and “special collateral” transactions, involving particularly valuable pieces of collateral for which lenders are willing to accept below general collateral rates.¹⁴ Even if general collateral rates are positive, the premium that lenders pay for special collateral may lead rates below zero. This premium is more likely to result in negative rates when general collateral rates are closer to zero, because at that level, even small premia will result in a negative rate.

While the OFR’s collection does not make a distinction between general and specific collateral repo directly, we can examine the effect of these special collateral transactions by looking at securities that are likely to be in specific demand. A classic example of securities in particular demand are on-the-run Treasuries, defined as the most recently issued Treasury of a particular maturity.¹⁵ In **Figure 5**, we plot repo volumes and repo specialness in the 10-year Treasury note against the number of business days since issuance, as well

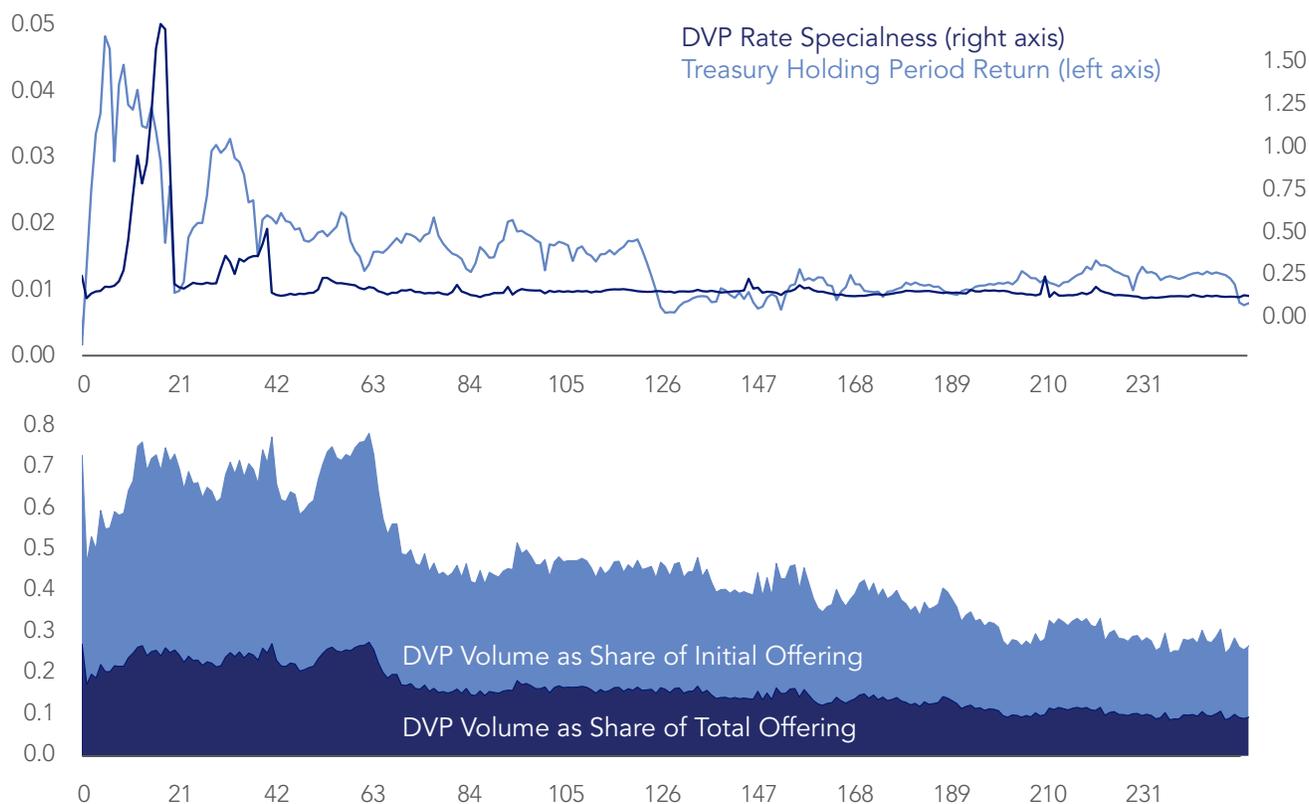
as showing holding period returns for Treasuries. Specialness in the top panel of this figure is estimated as the average rate on GCF overnight Treasury repo on a day minus the average rate in overnight DVP repo for the specific Treasury on that day. Holding period returns are the average daily return from purchasing a 10-year Treasury on its initial settlement day and holding it to the given day after issuance, before adjustment for coupons. Volumes in the bottom panel are presented as a share of the initial issuance and of the final issuance, where final issuance includes the volume that will be outstanding following the two standard reopenings for 10-year Treasuries, which are occasions when the Treasury increases the amount outstanding in a particular security. These reopenings occur at one and two months following the initial issuance.

As shown in the figure, both volumes and specialness increase directly preceding reopenings of the 10-year

(the first two gray vertical lines), which occur approximately 21 business days (roughly one month) and 42 business days (roughly two months) after the initial issuance. A similar pattern of specialness over the auction cycle is shown in an earlier period of data on inter-dealer brokered trades by D’Amico and Pancost (2018), though figures on volumes are not available.¹⁶ These reopenings also show a regular pattern with respect to Treasury prices, as the Treasury holding period returns show falling Treasury prices going into the Treasury reopening. After 63 days, the Treasury generally ceases to be on-the-run, and both volumes and specialness fall dramatically. The decline in prices at 126 days corresponds to the date at which the first coupon is paid.

The regular patterns of reopenings in the 10-year note present a particularly attractive opportunity for dealers to short Treasuries. On-the-run Treasuries are generally

Figure 5. DVP Specialness and Holding Period Returns (top, percent) and DVP Repo Volume (bottom, share) for 10-Year Treasury Note Collateral by Days Since Issuance



Note: Specialness is the weighted average overnight GCF repo rate using Treasury collateral less the weighted average rate on DVP repo using a specific Treasury as collateral on that day. Holding period returns are average one day returns from the issuance of the Treasury to that day since issuance using Treasury prices from January 2016 to September 2021, and are not adjusted for coupon payments. DVP series are calculated using transactions from November 2019 to September 2021.

Sources: Refinitiv Eikon, OFR Cleared Repo Collection, Office of Financial Research

in high demand, and the decline in prices apparent in the top panel reflects the scarcity of the on-the-run. Prior to a reopening, dealers can use repo to secure an on-the-run Treasury, and then sell that Treasury to one of their customers. In effect, this increases the supply of on-the-run Treasuries to the market. The dealer can then roll over their repo lending until the Treasury is reopened, when supply of the on-the-run will increase, and the dealer can purchase the on-the-run from this increased supply in order to satisfy their commitment to deliver this Treasury from their repo contract. The decline in prices which occurs prior to reopenings represents the benefits of this trade, while the specialness premium makes up one of the costs. This general strategy appears to underlie the large volumes in 10-year Treasuries prior to reopenings.

Special collateral demand for on-the-run Treasuries appears to have played a non-trivial role in negative repo rates. In **Figure 6**, we look at average rates for on-the-run, first-off-the-run, and all other Treasuries. Also displayed are the dates for reopenings and new issuances of 10-year Treasury notes. As shown, in recent months, on-the-run Treasuries often command rates well below off-the-run Treasuries, and consistent with the discussion above, rates are particularly low directly preceding reopenings. While first-off-the-run and second-off-the-run Treasuries generally do not have

repo rates below other off-the-run Treasuries, we can see that since April these also had a slight premium over other off-the-run Treasuries. However, while looking at on-the-run Treasuries provides a concrete example of specialness, special collateral demand need not be limited to on-the-run Treasuries. In **Figure 7**, we show that on-the-run collateral made up less than one third of negative-rate repo transactions since March 2021. Expanding to first- and second-off-the-run collateral still leaves more than half of negative rate transactions unexplained in May and June 2021.

A broader view of likely specials is provided by looking at collateral being demanded from the Federal Reserve's System Open Market Account (SOMA) securities lending facility by its participants. The SOMA securities lending facility offers an alternative source of collateral, lending out Treasuries held in the SOMA account. The SOMA facility allows participants to borrow Treasury collateral from the Federal Reserve overnight, for a rate determined through a competitive auction. The facility is capped both in aggregate and for individual participants and has a minimum bid rate of 5 basis points. When dealers reach their limits, rates on the SOMA facility will be bid up beyond this minimum. While Treasuries borrowed from the SOMA facility need not be on the run, the specialness estimated for the on-the-run 10-year Treasury is closely

Figure 6. DVP Repo Rates by Collateral Runness (percent)



Note: Repo data series are weighted average overnight rates for Treasury collateral in each runness category. Vertical black lines denote reopenings of the 10-year Treasury. Vertical orange lines denote issuance of a new 10-year Treasury.
Sources: OFR Cleared Repo Collection, Office of Financial Research

Figure 7. DVP Repo Rates by Collateral Runness (percent)

Month	On-the-Run		First and Second Off-the-Run		SOMA Collateral	
	All Transactions	Negative-rate Transactions	All Transactions	Negative-rate Transactions	All Transactions	Negative-rate Transactions
January	13.70	60.76	11.13	5.39	37.99	91.65
February	13.42	43.17	10.18	20.16	38.34	89.97
March	13.08	35.10	11.44	20.15	39.08	78.45
April	13.44	26.34	12.38	26.04	39.61	72.53
May	12.95	19.46	13.93	22.97	41.97	62.05
June	12.33	22.00	14.17	25.48	44.72	78.18

Note: Average daily percent of a given collateral class in all DVP transactions as well as all transactions in DVP at negative rates. SOMA collateral denotes transactions collateralized with Treasuries borrowed on the same day from the SOMA securities lending facility. Sources: OFR Cleared Repo Collection, Office of Financial Research.

correlated with the lending rate on on-the-run 10-year Treasuries charged by the SOMA facility, as can be seen in **Figure 8**. This suggests that using Treasuries borrowed from the SOMA facility will encompass the specialness observed for on-the-run Treasuries.

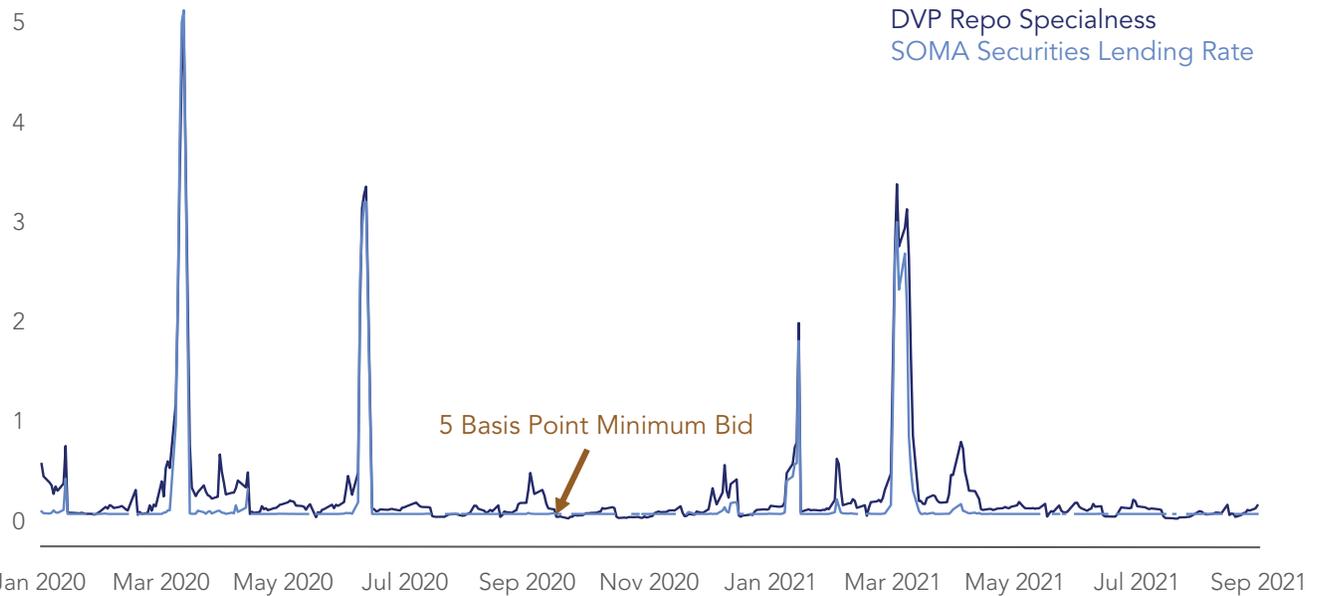
We match collateral in the DVP market to securities borrowed through the SOMA securities lending facility. In theory, the structure of SOMA securities lending should imply a close relationship with specials in DVP more generally. For collateral with a specific collateral rate less than 5 basis points below GC rates, SOMA securities lending will not be attractive. Once the premium reaches 5 basis points, we should expect to see activity in SOMA securities lending for that particular piece of collateral. Higher than 5 basis points, the SOMA facility should be exhausted, and rates at the facility should rise above SOMA securities lending rates. As **Figure 8** shows, this does not hold exactly, which may be due to both the timing of the facility relative to DVP trades and to the guaranteed delivery from the Federal Reserve implicit in SOMA securities lending.

In **Figure 9**, we employ SOMA securities lending data to inform our estimates of specials activity. We show three series of repo rates in this figure: (1) the average rate on DVP transactions collateralized with Treasuries that are also borrowed on that day from the SOMA, (2) DVP with all other collateral (not borrowed from the SOMA), and (3) GCF. The light blue area denotes 5 basis points below the average GCF rate. As shown, the average rate on SOMA collateral fell roughly 5 basis points or more below the GCF rate. Once this collateral is removed, the average rate in DVP was mostly positive, and always within 5 basis points of the GCF rate. Moreover, the SOMA filter captures a broader extent of negative rate activity, as shown in the last column of **Figure 7**.

5. Effect on the SOFR

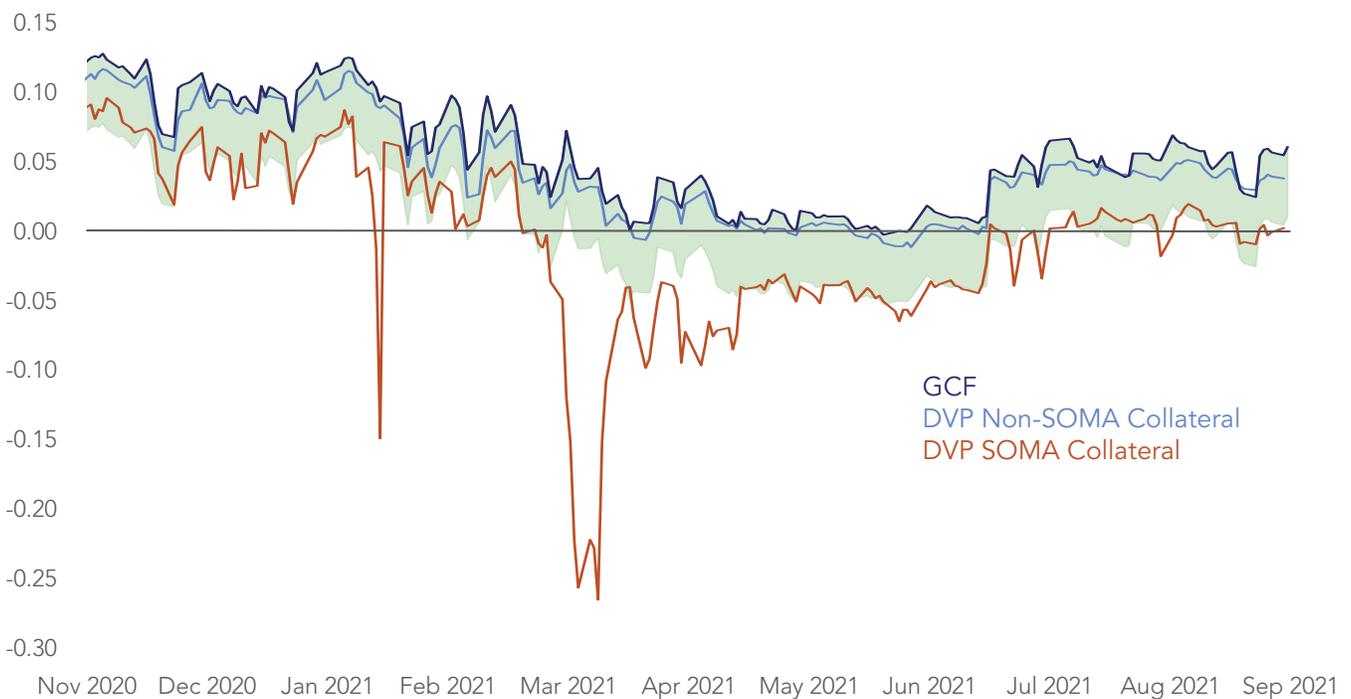
We next examine the effect of premia in the DVP repo market on the SOFR. As far as reference rates are concerned, the signs of rates entering into the SOFR distribution may be less important than the correlations between rates. Even had the median SOFR rate

Figure 8. Average SOMA Securities Lending Rate and DVP Repo Specialness for On-the-run Treasuries (percent)



Note: All rates are for the 10-year on-the-run Treasury. DVP repo specialness is estimated using the average rate on overnight Treasury GCF repo less the average rate on overnight DVP repo collateralized with the on-the-run 10-year Treasury.
Sources: Federal Reserve Bank of New York, OFR Cleared Repo Collection, Office of Financial Research.

Figure 9. GCF Rates and DVP Rates by Collateral Type (percent)



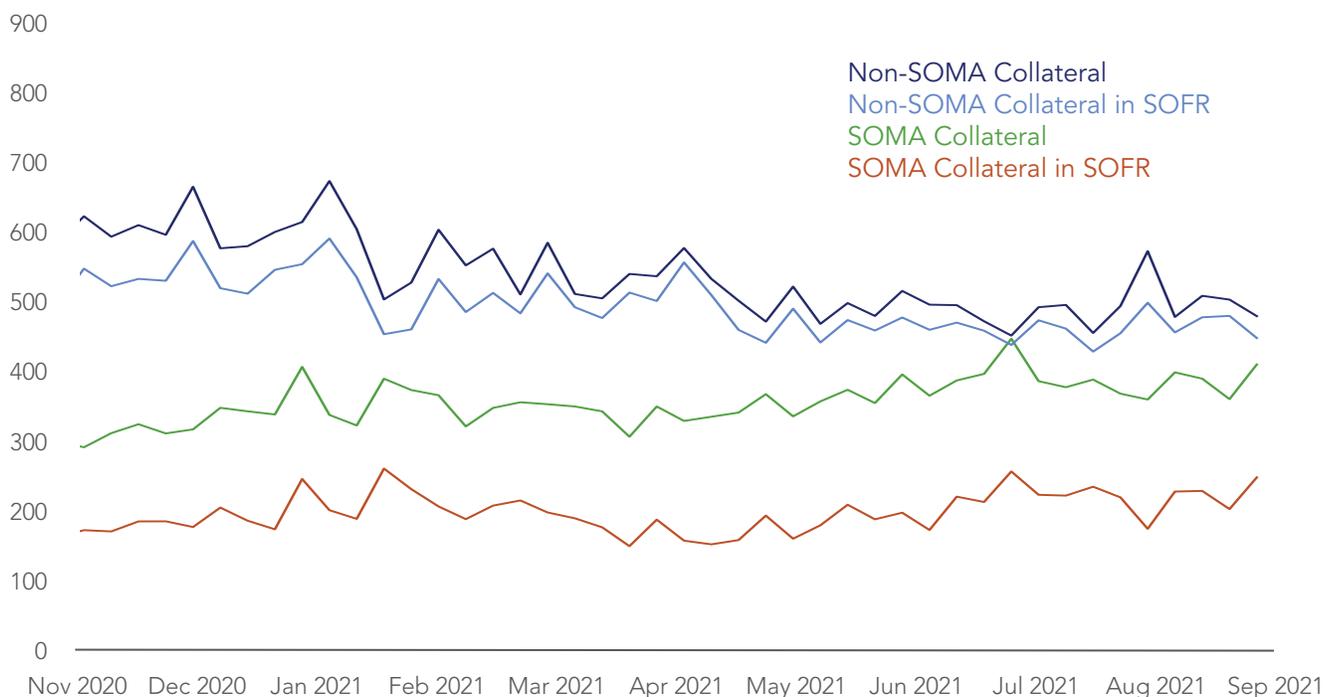
Note: All rates are weighted average overnight rates for Treasury collateral. Rates for "SOMA collateral" are weighted-average rates for DVP repo using collateral which also was borrowed from the SOMA securities lending facility on a given day. Non-SOMA collateral rates are weighted-average rates for all other Treasury collateral in DVP.
Sources: Federal Reserve Bank of New York, TreasuryDirect Auction Results, Office of Financial Research

turned negative, which did not occur during this period, a modest spread in contracts referencing the SOFR would have led to a positive rate overall, provided general collateral rates remained at or above zero. However, it would be more difficult for private agents to adjust contracts for the influence of rates underlying the SOFR that are not correlated with funding rates. The discussion above shows that special collateral rates associated with reopenings were large in 2021 and generally relatively unassociated with movements in funding rates, being driven instead by the issuance schedule for Treasuries. To limit the impact of these transactions, the construction of the SOFR takes steps to exclude special collateral transactions. In particular, a filter based on dropping the bottom 25th volume-weighted percentile of rates from transactions in DVP is applied before transactions are included in the SOFR distribution. Below, we show that despite large volumes at negative rates during 2021, this filter appears to have performed well.

To assess the effects of special collateral transactions on the SOFR, we again look at SOMA and non-SOMA

collateral, this time applying an additional filter based on the 25th percentile of rates in DVP which should closely approximate the one used in the calculation of the SOFR. **Figure 10** shows volumes in collateral that was borrowed on the same day from the SOMA securities lending facility, and volumes in all other collateral. Over the first half of 2021, the volume of SOMA collateral rose, while the volume of non-SOMA collateral fell, so that while SOMA collateral made up only about a third of DVP volumes in November 2020, it made up about half of volumes in July 2021. While nearly all non-SOMA collateral transactions were included in SOFR, only about half of transactions secured by SOMA collateral were included. This half of SOMA collateral transactions included in the SOFR sample may not represent specials. Collateral borrowed from the SOMA facility could be used for funding transactions on the same days it is used by other participants for special collateral transactions: for instance, money market funds (MMFs) generally attached rates to SOMA collateral that are nearly identical to the rates for non-SOMA collateral, reflecting the pure funding nature of MMF trades. On the other hand, a portion

Figure 10. DVP Volume by Collateral Type and Inclusion in the SOFR (\$ billions)



Note: All volumes are for overnight repo in DVP collateralized with Treasuries. SOMA collateral denotes repo transactions collateralized with Treasuries borrowed on the same day from the SOMA securities lending facility. Transactions are considered to be within SOFR distribution based on our reconstruction whenever the rate on the transaction falls above the 25th volume-weighted percentile of overnight Treasury rates within DVP.

Sources: OFR Cleared Repo Collection, Office of Financial Research

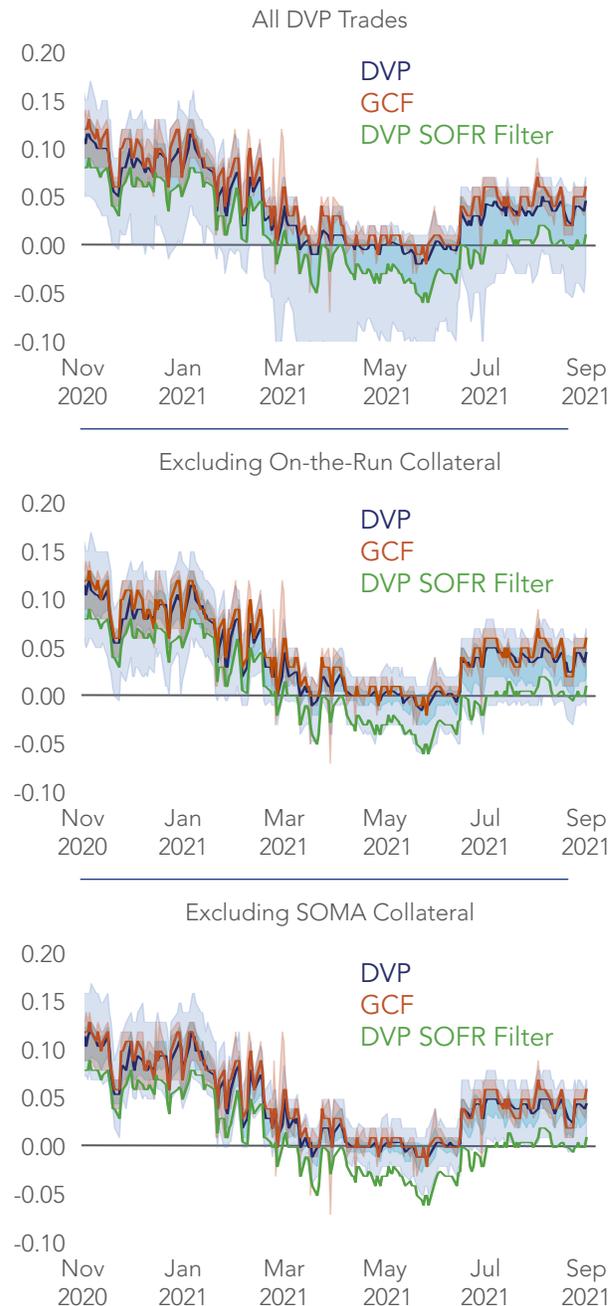
of the rise may have reflected the fact that if funding trades were becoming less popular in DVP, it is more likely that special collateral trades would pass through the filter and consequently be included in the SOFR. Below we argue this second explanation is unlikely.

In particular, **Figure 11** suggests that the 25th percentile filter included in the SOFR performs quite well in excluding special rates relative to alternative filters which would exclude on-the-run collateral or collateral borrowed from the SOMA securities lending facility. The three panels show, from top to bottom, (1) the distribution of rates in all DVP trades, (2) in DVP trades excluding the on-the-run through third-off-the-run Treasuries, and (3) in DVP trades excluding collateral that was borrowed from the SOMA facility on the same day. As can be seen, the steepest negative rates during 2021 are cut off by using the on-the-run filter, but prior to 2021 more negative rates remain. Using securities borrowed from the SOMA facility as a filter eliminates much of the lowest rates in DVP. As shown, however, the range of rates remaining after removing SOMA collateral or on-the-run collateral is very similar to rates after removing the 25th percentile, which is shown in gray. This confirms that relative to our proxies for specialness, the current SOFR filter is effective in excluding what are likely to be special collateral rates.

In addition, while using on-the-run collateral or SOMA collateral as a filter for likely specials may seem attractive, the current filter in the SOFR has substantial advantages in its implementation. Excluding the on-the-run and the first- through third-off-the-run Treasuries does remove the deepest negative rates; however, it is only effective when those securities are actually on special. When on-the-run collateral is not on special, the filter needlessly drops transactions collateralized with Treasuries that are generally popular in the repo market. Moreover, such a filter would miss seasoned Treasuries that happen to be on special.

On the other hand, excluding all collateral borrowed from the SOMA securities lending facility from the SOFR would have problematic consequences: Large volumes of DVP transactions would be excluded from the SOFR on the basis of (potentially) much smaller volumes of SOMA securities lending transactions, which could be as small as \$1 million in individual

Figure 11. Distribution of DVP Rates Excluding Certain Collateral (percent)



Note: For blue areas, lightly shaded areas denote the 10th to 90th weighted percentiles of overnight Treasury DVP rates, darker shaded area denotes the 25th to 75th weighted percentiles, and the line denotes the weighted median. For orange areas, lightly shaded areas denote the 10th to 90th weighted percentiles of GCF rates and the line denotes the weighted median. The green line denotes our reconstruction of the existing SOFR filter based on excluding the 25th weighted percentile of DVP rates. In the first panel, all DVP trades are included, while in the second panel DVP trades using the on-the-run through third-off-the-run Treasuries of each maturity are excluded, and in the third panel all collateral that is borrowed on the same day from the SOMA securities lending facility is excluded.

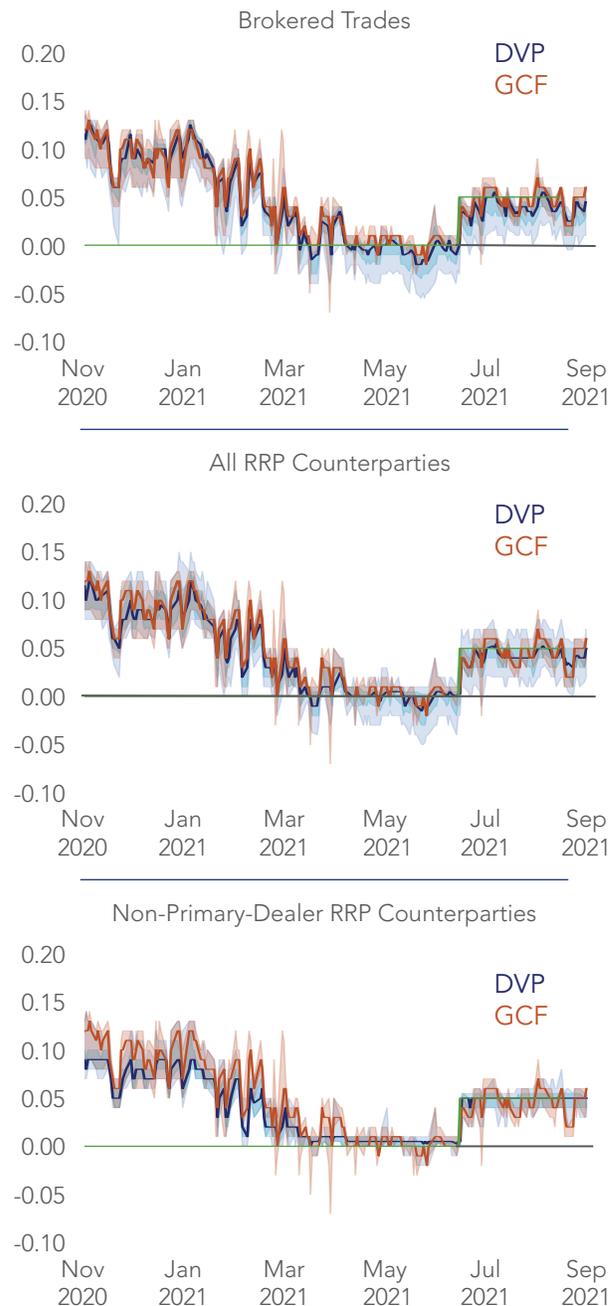
Sources: OFR Cleared Repo Collection, Office of Financial Research

securities. In recent periods, this approach would have excluded as much as half of all DVP trades from SOFR, as opposed to a quarter (the current filter), reducing the volumes underpinning this rate. In addition, the fact that SOFR rates remained positive during the spring 2021 period of negative rates suggests that the 25th percentile filter is already fairly robust to swings in special collateral demand.

Relative to GCF rates, there is still a wider range at the top and the bottom of the distribution in the third panel of **Figure 11**. The extremes of this range likely reflect both specific collateral rates below the 5-basis-point minimum bid for the SOFR facility and the greater variety of institutions involved in DVP. For example, non-clearing-members of the Fixed Income Clearing Corporation (FICC), such as money market funds and hedge funds, can participate in DVP through sponsored repo, whereas GCF is almost entirely clearing members. In general, sponsored borrowers pay higher rates than clearing members, while sponsored lenders receive lower rates.¹⁷ Moreover, trades in GCF are blind brokered while trades in DVP can be either brokered or unbrokered.

In **Figure 12**, we investigate the importance of institution types and outside options in the spread of repo rates. All three panels of **Figure 12** begin with the same filter based on collateral borrowed from SOMA as in the last panel of **Figure 11**. In the first panel of **Figure 12**, we also limit transactions to those going through inter-dealer brokers, thus cutting out sponsored borrowers and lenders. This brings the upper tail of remaining DVP rates in line with GCF. However, the lower tail in this panel falls slightly relative to the third panel in **Figure 11**, which may seem puzzling. The third panel limits the sample to counterparties that have the option to lend to the ON-RRP facility but who are not primary dealers. Sponsored lending, which has been excluded in the first panel, is mainly dominated by money market funds, with a small presence from hedge funds and other lenders. Many of these funds have access to the ON-RRP facility, allowing them to invest overnight at zero with the Federal Reserve. As can be seen, the average rate received by ON-RRP counterparties has remained above zero for all of 2021, so excluding these trades is likely to decrease the lower tail of rates. A portion of these positive rates could be

Figure 12. Distribution of DVP Rates Excluding SOMA Collateral and Certain Counterparties (percent)



Note: For blue areas, lightly shaded areas denote the 10th to 90th weighted percentiles of overnight Treasury DVP rates, excluding collateral which is borrowed on that day from the SOMA securities lending facility, darker shaded area denotes the 25th to 75th weighted percentiles, and the line denotes the weighted median. For orange areas, lightly shaded areas denote the 10th to 90th weighted percentiles of GCF rates and the line denotes the weighted median. The green line denotes the ON-RRP facility rate. In the first panel, only brokered trades are included, while in the second panel only trades where the lender is an ON-RRP counterparty are included, and in the third panel only non-primary-dealer ON-RRP counterparties are included.
Sources: OFR Cleared Repo Collection, Office of Financial Research

attributed to money market funds' unwillingness to lend at negative rates, but we can also see that after the ON-RRP rate is raised by 5 basis points in mid-June 2021, the rate for money market funds rises in tandem.

At the same time, much of the brokered market is made up of primary dealers, who also have access to the ON-RRP facility. After including these dealers and other ON-RRP facility counterparties in the second panel, their rate does not follow the ON-RRP rate nearly so closely. Looking at the second and third panel, it is clear that primary dealers are often receiving lower rates than other ON-RRP counterparties. These lower rates for primary dealers – despite the availability of the ON-RRP facility to them – likely reflect a confluence of factors.

First, dealers may be willing to receive lower rates than ON-RRP facility rates in both DVP and GCF because of netting benefits that DVP provides, since their lending is recorded as being with FICC and can be offset by borrowing from FICC. This is not, by itself, consistent with lower rates for primary dealers than in GCF (which also confers these benefits) but may explain the higher correlation between median GCF and DVP rates once primary dealers are included alongside other ON-RRP counterparties.

Second, the ON-RRP facility is generally open between 12:45 pm and 1:15 pm, long after most dealer trades are completed. Dealers may be willing to pay a premium to secure valuable collateral earlier in the day, consistent with the high early-morning volumes at negative rates noted in Clark et al. (2021).¹⁸ DVP may be a particularly attractive venue for this activity because of the relative ease of reusing collateral procured within this market.

Finally, dealers who already have access to GCF may be more likely to be accessing DVP for specific collateral. To the extent that our filter does not control for low degrees of specific collateral demand where the premium is smaller than the 5-basis-point minimum bid, these small specials premia may lead to a lower rate for primary dealers than for other counterparties.

6. Conclusion

Recent negative rates in bilateral repo markets have occurred in an environment of already low rates

spurred in part by a large increase in reserves. The DVP repo market has a broader distribution of rates than general collateral, tri-party markets such as GCF, and this broader distribution has meant that many trades in DVP repo have been transacted at negative rates. Much of this distribution of rates can be explained by the features specific to the DVP repo market – in particular, the prevalence of special collateral transactions within DVP. We show evidence that existing filters in the construction of the SOFR are largely successful in limiting the impact of specials.

Negative rates in bilateral markets associated with specific collateral serve an important purpose. The premium for special collateral creates a cost to shorting Treasuries, and potentially prevents short positions from becoming exorbitantly large. Since short positions carry with them the possibility of failures to deliver, a premium for those transactions leads to an ex-ante private cost to institutions creating this risk. The presence of this cost is especially valuable when weighted against the possibility of cascading failures to deliver in the Treasury market. For trades that do not involve specific collateral demand, as defined in our filters, our results suggest that the ON-RRP facility provides a fairly strong floor on rates for its counterparties. While maintaining that floor has involved record high volumes at the ON-RRP facility in 2021, it has allowed money market funds to invest while maintaining a stable net asset value (NAV). The increase in the ON-RRP facility rate in June 2021 appears to have been effective in raising the minimum funding rates that participants were willing to accept.

Looking ahead, further reductions in the TGA combined with generally high levels of reserves and low bill issuance may keep the general collateral rate at the lower bound set by the ON-RRP facility for some time. Our results suggest this facility is likely to keep funding rates in the repo market positive, but even with general collateral rates set at five basis points, we are likely to continue to see occasional bouts of negative rates in DVP during periods in which specific collateral demand is particularly strong. The determinants of this special collateral demand, and their relation to broader issues of Treasury market functioning, remain a promising avenue for future research.

Endnotes

- 1 Samuel J. Hempel, Research Economist, Office of Financial Research (samuel.hempel@ofr.treasury.gov) and R. Jay Kahn, Research Economist, Office of Financial Research (robert.kahn@ofr.treasury.gov). The views expressed in this brief are those of the authors and do not necessarily represent those of the Office of Financial Research or the U.S. Department of the Treasury. We thank Sriram Rajan, Mark Paddrik, Nagpurnanand Prabhala, and Matthew McCormick for their comments and suggestions. The authors alone are responsible for any errors in this brief.
- 2 Source: OFR US Repo Markets Data Release, DVP Service Average Rate: Overnight/Open
- 3 See Federal Reserve Bank of New York, “Additional Information about Reference Rates Administered by the New York Fed” <https://www.newyorkfed.org/markets/reference-rates/additional-information-about-reference-rates>
- 4 Fleming, Michael J. and Kenneth D. Garbade. “Repurchase Agreements With Negative Interest Rates.” Federal Reserve Bank of New York *Current Issues in Economics and Finance* 10, no. 5 (2004, April): 1-7. https://www.newyorkfed.org/medialibrary/media/research/current_issues/ci10-5.pdf
- 5 For more institutional details on Treasury reopenings, see TreasuryDirect, “Treasury Reopenings” <https://www.treasurydirect.gov/instit/auctfund/work/reopenings/reopenings.htm>
- 6 We identify individual securities using CUSIP (Committee on Uniform Securities Identification Procedures) numbers.
- 7 See Federal Reserve Bank of New York, “Additional Information about Reference Rates Administered by the New York Fed” <https://www.newyorkfed.org/markets/reference-rates/additional-information-about-reference-rates>
- 8 Bowman, David, Joshua Loria, Matthew McCormick, and Mary-Frances Styczynski. “The Cleared Bilateral Repo Market and Proposed Repo Benchmark Rates.” FEDS Notes 2017-02-27, Washington: Board of Governors of the Federal Reserve System, February 2017. <https://www.federalreserve.gov/econresdata/notes/feds-notes/2017/cleared-bilateral-repo-market-and-proposed-repo-benchmark-rates-20170227.html>
- 9 See Correa, Ricardo, Wenxin Du, and Gordon Liao. “U.S. Banks and Global Liquidity.” International Finance Discussion Papers 1289, Washington: Board of Governors of the Federal Reserve System, July 2020. <https://www.federalreserve.gov/econres/ifdp/files/ifdp1289.pdf>
- 10 Examples of articles discussing the SLR exemption and the shift from reserves to money market funds include Klein, Matthew C. *How a Regulatory Tweak Will Affect Banks, Money Funds, and the Financial System*. Online Content, Barron’s, March 26, 2021. <https://www.barrons.com/articles/how-a-regulatory-tweak-will-affect-banks-money-funds-and-the-financial-system-51616785245> See also Moise, Imani. *Cash-Rich U.S. Banks Move to Reduce Corporate Deposits*. Online Content, New York: Financial Times, May 3, 2021. <https://www.ft.com/content/a5e165f7-a524-4b5b-9939-de689b6a1687>
- 11 For more discussion of the roles of IOER and ON-RRP in controlling overnight rates, see Logan, Lorie K. “Impact of Abundant Reserves on Money Markets and Policy Implementation.” SIFMA Webinar. Online, April 15, 2021. <https://www.newyorkfed.org/newsevents/speeches/2021/log210415> See also Frost, Josh, Lorie Logan, Antoine Martin, Patrick McCabe, Fabio Natalucci, and Julie Remache. “Overnight RRP Operations as a Monetary Policy Tool: Some Design Considerations,” Finance and Economics Discussion Series 2015-010, Washington: Board of Governors of the Federal Reserve System, February 2015. <https://www.federalreserve.gov/econresdata/feds/2015/files/2015010pap.pdf>
- 12 For the complete list of the ON-RRP’s eligible counterparties, including historical additions and removals, see Federal Reserve Bank of New York, “Reverse Repo Counterparties” https://www.newyorkfed.org/markets/rfp_counterparties
- 13 The use of bilateral repo to source specific collateral can create confusion about which party is the ‘lender’ and which party is the ‘borrower.’ By convention, we refer to the repo lender as the party who is lending cash and receiving a specific security as collateral to secure the cash loan. Thus, a dealer interested in acquiring a specific piece of collateral will be labeled the ‘lender,’ even when they are effecting the transaction for the purpose of acquiring a specific security that is delivered by the ‘borrower’ as collateral.
- 14 For a general discussion of special repo rates, see, among others, Duffie, Darrell. “Special Repo Rates.” *Journal of Finance* 51, no. 2 (1996, June): 493-526.; Jordan, Bradford D. and Susan

D. Jordan. “Special Repo Rates: An Empirical Analysis.” *Journal of Finance* 52, no. 5 (1997, December): 2051-2072.; Buraschi, Andrea and Davide Menini. “Liquidity Risk and Specialness.” *Journal of Financial Economics* 64, no. 2 (2002, May): 243-284.; and D’Amico, Stefania, Roger Fan, and Yuriy Kitsul. “The Scarcity Value of Treasury Collateral: Repo-Market Effects of Security-Specific Supply and Demand Factors.” *Journal of Financial and Quantitative Analysis* 53, no. 5 (2018, October): 2103-2129.

15 Another example are Treasuries which are cheapest-to-deliver into a Treasury futures contract which in recent years have commanded similar liquidity premia to on-the-run Treasuries (see Barth, Daniel and R. Jay Kahn. “Hedge Funds and the Treasury Cash-Futures Disconnect.” Working Papers 21-01, Washington: Office of Financial Research, April 2021. <https://www.financialresearch.gov/working-papers/files/OFRwp-21-01-hedge-funds-and-the-treasury-cash-futures-disconnect.pdf>). While we have seen some specialness associated with the 10-year cheapest-to-deliver on particular days in 2021, these positions have been small relative to those in on-the-run Treasuries.

16 D’Amico, Stefania and N. Aaron Pancost. “Special Repo Rates and the Cross-Section of Bond Prices: the Role of the Special Collateral Risk Premium.” *Working Paper Series* 2018-21, Chicago: Federal Reserve Bank of Chicago, December 2018. <https://www.chicagofed.org/publications/working-papers/2018/2018-21>

17 See Kahn, R. Jay and Luke Olson. “Who Participates in Cleared Repo?” Briefs 21-01, Washington: Office of Financial Research, July 2021. https://www.financialresearch.gov/briefs/files/OFRBr_21-01_Repo.pdf

18 Clark, Kevin, Adam Copeland, R. Jay Kahn, Antoine Martin, Mark Paddrik and Benjamin Taylor. “Intraday Timing of General Collateral Repo Markets.” *Liberty Street Economics* 20210714, New York: Federal Reserve Bank of New York, July 2021. <https://libtystreeteconomics.newyorkfed.org/2021/07/intraday-timing-of-general-collateral-repo-markets/>