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Abstract

In March 2020, massive customer selling of U.S. Treasury securities and agency mortgage-backed securities (MBS) triggered by the COVID-19 pandemic overwhelmed dealers’ capacity to intermediate trades, contributing to a marked deterioration of market functioning. The Federal Reserve promptly took numerous steps to address the market disruptions, including the initiation of market functioning purchases of Treasury securities and agency MBS. Purchases quickly expanded to over \$100 billion per day as the Fed announced plans to buy securities “in the amounts needed” to support market functioning and the effective transmission of monetary policy. Market liquidity improved steadily after mid-March, suggesting that the Fed’s efforts were effective, and the security purchases were scaled back accordingly.

Key words: Federal Reserve, asset purchases, Treasury securities, agency mortgage-backed securities, COVID-19

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Introduction

The COVID-19 pandemic had extraordinary effects on U.S. financial markets. U.S. Treasury securities are usually thought to benefit from a flight to safety during times of crisis, as investors exit positions with greater credit risk and bid up the prices of Treasuries (Noeth and Sengupta, 2010). Treasury prices followed this pattern in the early months of the pandemic, with the yield on the 10-year note (which moves inversely to its price) plunging from 1.92% on December 31, 2019 to a record low 0.55% on March 9, 2020. Starting March 10, however, Treasury prices reversed and fell sharply, with the yield on the 10-year note rising 65 basis points between March 9 and March 18. Prices of agency mortgage-backed securities (MBS) dropped even more steeply over this period, with the yield for current coupon agency MBS rising roughly 100 basis points.

The unusual price changes were accompanied by a marked deterioration of market functioning (Duffie, 2020; Logan, 2020a, 2020b). Treasury market liquidity deteriorated to its worst levels since the 2007-09 global financial crisis, amidst the worst recession since World War II, with wide bid-ask spreads, low market depth, and a high price impact of trades (Fleming, 2020, and Fleming and Ruela, 2020). Agency MBS bid-ask spreads and price impact followed a similar pattern. Pricing dislocations also arose among securities with similar cash flow characteristics, suggesting a breakdown of arbitrage relationships (Schrimpf, Shin, and Sushko, 2020).

The Federal Reserve promptly took numerous actions to address the market disruptions (Fleming, Sarkar, and Van Tassel, 2020, Clarida, Duygan-Bump, and Scotti, 2021, and Federal Reserve Bank of New York, 2021). On March 15, 2020, in particular, the Federal Open Market Committee (FOMC) announced it would increase its holdings of Treasury securities by at least \$500 billion and its holdings of agency MBS by at least \$200 billion to support market functioning and hence the flow of credit to households and businesses (Board of Governors, 2020a).¹ It then

¹ Note that the Federal Reserve is composed of many different parts, each of which has different roles. The FOMC authorizes and directs the Federal Reserve Bank of New York (New York Fed) to undertake various open market operations usually for the System Open Market Account. The FOMC's directives are typically addressed to the Open Market Trading Desk, a unit within the New York Fed's Markets Group. The FOMC also establishes the target range for the federal (fed) funds rate. The Board of Governors of the Federal Reserve System (the Board) adopts regulations, authorizes Reserve Bank lending facilities under Section 13(3) of the Federal Reserve Act with the approval of the Secretary of the Treasury, and sets the rates on interest on reserves. Reserve Bank Boards of Directors set the primary and secondary rate for discount window lending, which are subject to review and determination by the Board. For ease of reference, this paper often uses the term "the Fed" to describe the actor, even though one or more different individual constituent parts of the Fed may be acting.

announced on March 23 it would continue to purchase Treasuries and agency MBS “in the amounts needed” to support market functioning and the effective transmission of monetary policy (Board of Governors, 2020b).

The Fed’s purchases were expected to improve market functioning through multiple channels, including by offsetting the massive sales being undertaken by foreign investors, hedge funds, and mutual funds (Logan, 2020a; 2020b). A key role of dealers is to intermediate customer flows, and dealers in fact sharply increased their securities holdings in response to customer sales. However, dealers became overwhelmed by the level and persistence of the sales amidst unusually high volatility and historic trading volume. Moreover, dealers entered the pandemic with already high Treasury holdings, further limiting their capacity to absorb the immense selling pressure.

The most striking aspects of the market functioning purchases were their innovativeness and their unprecedented speed and scale. In terms of speed and scale, the purchases quickly reached over \$100 billion per day and totaled over \$2 trillion between March 13 and April 30 alone. In terms of innovativeness, the Fed varied the pace and distribution of purchases based on observable measures of market functioning, reflecting the particular motivation for the purchases. It also adjusted the settlement timing of some MBS operations, allowing market participants to quickly obtain cash for their MBS sales, reducing funding pressures in the market. The Fed also for the first time purchased agency commercial mortgage-backed securities (CMBS) to support the smooth functioning of this important market (Park, Gouny, and Liu, 2020).

There were also aspects of the market functioning purchases that were not new. In particular, the Fed relied on a tool (open market operations) that it commonly uses in its implementation of monetary policy. In addition, the Fed purchased securities in large quantities during and after the global financial crisis (albeit for different purposes) and had purchased securities to support market functioning in episodes before that. More generally, the Fed was created, at least in part, to ensure a more stable financial system, and it has traditionally been a liquidity provider of last resort, so the market functioning purchases fit well within the Fed’s purview.

While it is difficult to pin down the effects of the Fed’s purchases amidst the pandemic and numerous policy actions, the evidence suggests they were effective. Many Treasury market

liquidity measures reached their nadir Friday, March 13, before improving immediately after the initiation of the purchases was announced on Sunday, March 15. Nonetheless, conditions remained unusually illiquid through March 23, when the Fed dropped explicit quantity limits on its total purchases, but improved notably the next day. Agency MBS liquidity metrics broadly followed a similar pattern. As market conditions improved, purchases were scaled back, dropping from a daily average of \$104 billion in late March, to \$18 billion in late April, and \$9.5 billion in late May.

The rest of the article is organized as follows. In Section 1, we present evidence on the market disruptions caused by the pandemic that spurred the Fed to respond. Section 2 then discusses how the market functioning purchases were conducted, what they were intended to do, and their limitations and drawbacks. In Section 3, we provide information on the purchases themselves and their effects on market functioning. Section 4 concludes.

1. THE MARCH 2020 MARKET DISRUPTIONS

1.1. Early 2020

Fixed income yields declined at a modest pace in early 2020 amidst limited financial market volatility and generally increasing equity prices. The ten-year Treasury yield declined about 60 basis points (from 1.92 percent to 1.34 percent) between December 31, 2019, and February 26 (Chart 1). MBS prices were stable relative to Treasury prices, with the option-adjusted-spread (OAS) relative to Treasuries for current coupon universal mortgage-backed securities (UMBS) staying within a narrow range of 24 - 31 basis points (Chart 2).² The World Health Organization had been informed of the COVID-19 outbreak on December 31, but the first reported case in the United States did not come until January 21, and the first possible community transmission in the U.S. was not announced until February 26.³

Increased concerns about the effects of the pandemic drove fixed income yields and equity prices sharply lower and volatility higher. Between February 26 and March 9, the ten-year Treasury

² The appendix provides an overview of the agency MBS market, including a description of to-be-announced (TBA) trading and UMBS.

³ [“COVID-19 – China,”](#) World Health Organization Disease Outbreak News, January 5, 2020, [“First Patient With Wuhan Coronavirus Is Identified in the U.S.,”](#) *New York Times*, February 21, 2020, and [“C.D.C. Confirms First Possible Community Transmission of Coronavirus in U.S.,”](#) *New York Times*, February 26, 2020.

yield plunged nearly 80 basis points from 1.34 percent to a record low of 0.55 percent. Changes in agency MBS yields tracked changes in Treasury yields during this time. The yield for current coupon UMBS dropped from 2.17 percent on February 26 to 1.49 percent on March 9, with the OAS remaining fairly stable around 30 basis points. The S&P 500 equity index dropped 3 percent or more on February 24, 25, and 27, and then 7.6 percent on March 9, triggering a circuit breaker that temporarily halted trading.

Treasury liquidity, which had shown little signs of stress through late February, started to deteriorate, most notably on Friday, March 6, and Monday, March 9. The spreads between the highest bid prices and the lowest ask prices for the on-the-run (most recently auctioned) five-, ten-, and thirty-year securities widened (Chart 3) and the quantities available to transact at those quoted prices declined (Chart 4).⁴ Moreover, price impact – a measure of how much trading in a given direction affects prices – increased (Chart 5). There is also some evidence of widening bid-ask spreads (Chart 6) and increased price impact (Chart 7) for agency MBS at this time, although the trend is less clear, perhaps because the MBS liquidity measures are estimated less precisely.⁵

1.2 The Dash for Cash

After sharply falling, longer-term yields abruptly reversed between March 9 and March 18, with the ten-year yield quickly rising 65 basis points (from 0.55 percent to 1.20 percent) and the yield for current coupon UMBS rising about 100 basis points (from 1.49 percent to 2.50 percent).⁶ Treasury volatility also rose sharply, peaking at its highest level since the global financial crisis on March 13, and the S&P 500 declined, on net, amid unusually high equity volatility.⁷ In addition, Treasury liquidity deteriorated, with bid-ask spreads (Chart 3) and price impact (Chart 5) reaching their highest levels, and order book depth (Chart 4) its lowest levels, since the global financial crisis,

⁴ Bid-ask spreads for off-the-run (seasoned) issues widened even more in March 2020 as shown in Logan (2020a) and Clarida, Duygan-Bump, and Scotti (2021).

⁵ Treasury bid-ask spreads are measured directly using quoted prices from a central limit order book from the interdealer market and Treasury price impact is calculated using high frequency measures of order flow and bid-ask midpoint changes from the same market. In contrast, MBS bid-ask spreads and price impact are inferred from transaction prices over the full course of a trading day.

⁶ Treasury bill yields were steadier in early 2020, especially at the short end, declined sharply over the February 26 to March 9 period, and then declined further between March 9 and March 18 when note and bond yields were rising.

⁷ Our characterization of volatility is based on the realized volatility measure plotted in Chart 1. Implied volatility, as measured by the ICE BofAML MOVE Index, exhibits a similar pattern, rising sharply March 6, remaining unusually high between March 9 and March 23, and dropping sharply March 24, albeit peaking on March 9.

mostly on March 13.⁸ Agency MBS liquidity also dried up, with bid-ask spreads (Chart 6) and price impact (Chart 7) peaking around March 20.

There were also pricing dislocations among securities with similar cash flow characteristics, suggesting a breakdown of arbitrage relationships. In the Treasury market, the yield spread between on-the-run and off-the-run securities with similar maturities widened (Chart 8), suggesting that investors were placing greater value on the relatively more liquid on-the-run securities (and/or that the liquidity of the off-the-run securities had worsened to a greater extent). Futures prices also became detached from the prices of the associated cash securities, and the dispersion of yields around a smoothed yield curve increased (Duffie, 2020; Schrimpf, Shin, and Sushko, 2020; Barth and Kahn, 2021).

For agency MBS, price dislocations arose between the specified pool (SP) market and the to-be-announced (TBA) market. TBA prices generally serve as an effective lower bound for prices in the SP market. This is because TBA sellers tend to deliver less valuable pools to settle TBA contracts (given the cheapest-to-deliver option), resulting in lower prices. To avoid this discount in the TBA market, owners of premium MBS prefer to sell their securities in the SP market. The gap between SP and TBA prices, also known as pay-up, shrank dramatically in March 2020 (Chart 9). One explanation is that investors sold MBS disproportionately in the SP market (in which time to settlement can be shorter) because they could not wait for the longer time to settlement in the TBA market to receive cash for their sales (Chen, et al., 2020).

Another dislocation in the agency MBS market concerned pricing relative to the Treasury market. Agency MBS are guaranteed by an agency of the U.S. government (Ginnie Mae) or a government-sponsored enterprise (Fannie Mae and Freddie Mac), and hence considered almost as safe as Treasury securities. This helps explain agency MBS' remarkably stable OAS before the COVID-19 market stress (Chart 2). However, after the start of the liquidity crisis, pricing of agency MBS relative to Treasury securities experienced large swings, even on an intraday basis (Chart 10).

A defining feature of this episode, aside from (and related to) the rising Treasury yields, was the massive selling of off-the-run Treasury notes and bonds and agency MBS by a broad range of

⁸ Again, these metrics are for the on-the-run notes and bonds and based on data from the interdealer market. Bid-ask spreads for off-the-run securities peaked a few days later, as shown in Clarida, Duygan-Bump, and Scotti (2021).

investors (Chart 11). Mutual funds faced investor outflows and chose to first sell their most liquid assets to meet redemptions (Ma, Xiao, Zeng, 2020). There was also record selling of Treasury notes and bonds by foreign investors, including foreign central banks (Duffie, 2020; Logan, 2020a). Unwinding of relative value trades was likely a contributing factor to the selling. Leveraged investors that sought to profit from small pricing differences between Treasury securities in the cash market and the corresponding futures contracts reportedly started unwinding their positions as futures prices rose, causing both volatility and margins to increase and resulting in a classic margin spiral in which illiquidity, volatility, and increased margins reinforced one another (Schrimpf, Shin, and Sushko, 2020; Barth and Kahn, 2021). Some of the selling may not have been for immediate liquidity needs, but a precaution against a further deterioration in market functioning in a remote work environment (Logan, 2020b).

The customer selling of Treasuries was offset to a certain extent by substantial dealer purchases. Broker-dealers provide liquidity by standing ready to take the opposite side of their customers' trades, and by holding such positions until they can be offset in the interdealer market or with other customers. With higher price volatility, less stable pricing relationships between Treasury instruments, and lower overall market liquidity, making markets became much riskier for dealers in March 2020. Dealers faced balance sheet constraints and internal risk limits, preventing them from meeting the dramatic increase in liquidity demand on normal terms.

Broker-dealers provide liquidity in the MBS market as well as the Treasury market. In March 2020, dealers were, on net, buying from customers in the SP market and selling to customers in the TBA market and, in so doing, absorbing massive selling pressure in the SP market (Chart 12). This participation stands in contrast to the 2013 fixed income sell-off, when dealers reduced their net positions in agency MBS (Adrian, et al., 2013). However, price dislocations, including reduced pay-up, continued through at least early April, suggesting that dealer liquidity provision was insufficient.

Dealer intermediation led to a sharp increase in primary dealers' holdings of Treasury notes and bonds and agency MBS (Chart 13).⁹ In the week ending Wednesday, March 18, primary

⁹ Primary dealers are trading counterparties of the New York Fed in its implementation of monetary policy. They are also expected to make markets for the New York Fed on behalf of its official accountholders as needed, and to bid on a pro-rata basis in all Treasury auctions at reasonably competitive prices. The expectations and requirements of primary dealers, along with the current list, are available on the Markets Group's [Primary Dealers](#)

dealers' agency MBS holdings reached \$113 billion, a record high, and their Treasury note and bond holdings \$222 billion, just slightly below their May 2019 high. The four-week increase in primary dealer holdings was also the highest on record for both Treasury notes and bonds and agency MBS. The sharp increases occurred amidst a backdrop of elevated dealer positions, which had increased notably in late 2018. Dealers' holdings entering the pandemic, combined with the elevated uncertainty and volatility, limited their capacity to absorb the immense customer flows.

The challenges facing intermediaries were not limited to dealers. Another important set of intermediaries – principal trading firms (PTFs) – reduced their share of trading activity sharply in March 2020 (Chart 14). A PTF is a firm that invests for its own account, and that often employs automated trading strategies in which speed is a key element. Such firms account for most activity on the electronic interdealer broker platforms (Harkrader and Puglia, 2020). The high volatility, illiquidity, and unpredictability of flows in March 2020 caused PTFs to reduce their intermediation capacity relative to dealers and hence PTFs' share of trading activity to decline.¹⁰ Reduced liquidity in the interdealer market in turn exacerbated dealers' challenges in intermediating customer flows.

1.3 The Fed's Response

While the FOMC cut the federal (fed) funds target rate on March 3, in light of the risks to economic activity, the Fed's responses to the market disruptions specifically began several days after that. The New York Fed's Open Market Trading Desk increased the sizes of its repurchase agreement (repo) operations on March 9, and announced on March 11 that it would offer longer term repos, "to support the smooth functioning of funding markets."¹¹

On March 12, the Desk then announced that, pursuant to instruction from the Chair, it was changing the maturity composition of its reserve management purchases "to support functioning in the market for U.S. Treasury securities," and on March 13 that it was bringing forward these and

page. Note that primary dealers' bill holdings declined markedly between February 26 and March 25 which, combined with the sharp decline in bill yields over this period, suggests that some customers sought to convert note and bond holdings into bill holdings and not just cash.

¹⁰ Such behavior differs markedly from the October 15, 2014 flash rally when PTFs generally increased their share of trading activity (Joint Staff Report, 2015). One difference between the episodes was the sustained period of high volatility in March 2020. Note that PTFs increased their level of activity sharply in late February and early March 2020 as overall trading volume surged, and then decreased both their level and share of activity in mid-March.

¹¹ The Desk's statements announcing changes to the operating policies for conducting open market operations are listed on the Markets Group's [Statements and Operating Policies](#) page. As noted in the statements, these changes were consistent with the FOMC's directive to the Desk.

other purchases “to address highly unusual disruptions in the market for Treasury securities associated with the coronavirus outbreak” and “ to foster smooth Treasury market functioning and efficient and effective policy implementation.”¹²

On March 15, the FOMC announced it would increase its holdings of Treasuries by at least \$500 billion and its holdings of agency MBS by at least \$200 billion over coming months “to support the smooth functioning of markets ... that are central to the flow of credit to households and businesses” (Board of Governors, 2020a). On March 23, the FOMC announced additional steps to address market strains by continuing to purchase Treasuries and agency MBS “in the amounts needed to support smooth market functioning and effective transmission of monetary policy to broader financial conditions” (Board of Governors, 2020b). The committee also announced March 23 that it would include purchases of agency CMBS in its agency MBS purchases.

While our focus is on the market functioning purchases, the Fed took additional actions in March and early April 2020 (aside from changes to its repo operations mentioned above) to mitigate the disruptions to the Treasury and related markets: 1) It established the Primary Dealer Credit Facility to provide funding to primary dealers, which are key market makers for Treasuries and other securities; 2) It made changes to standing swap lines (in coordination with other central banks) and reintroduced temporary swap lines with additional central banks to lessen strains in U.S. dollar funding markets; 3) It launched the FIMA Repo Facility to allow foreign central banks to raise U.S. dollars against their holdings of Treasury securities at the Fed, reducing their incentive to sell Treasuries in the open market; and 4) It temporarily changed its supplementary leverage ratio rule, excluding Treasuries and deposits at the Fed from the calculation of the rule for holding companies, thereby providing the firms increased balance sheet space to act as financial intermediaries.

The Fed took numerous other actions to address the economic and financial disruptions caused by the pandemic. The FOMC cut the fed funds target rate on March 3, as mentioned above, and again on March 15 – concurrent with the announcement of market functioning purchases –

¹² As discussed later, reserve management purchases of Treasury bills were being conducted at a rate of \$60 billion per month to maintain ample reserve balances. Moreover, the principal payments from agency debt securities (that is, direct housing agency obligations) and agency mortgage-backed securities, up to \$20 billion per month, were being reinvested in Treasuries, and principal payments in excess of \$20 billion per month were being reinvested in agency MBS.

citing risks to economic activity from the coronavirus. The Fed also announced other measures on March 15 to support the credit needs of households and businesses, including lowering the primary credit rate (the discount window borrowing rate for banks). Moreover, the Fed established a series of funding and liquidity facilities in coordination with the U.S. Treasury to support credit to businesses of varying sizes, to mitigate disruptions in short-and medium-term funding markets, and to help state and local governments manage cash flow pressures.¹³

2. THE PURCHASES' RATIONALE, OPERATIONS, AND LIMITATIONS

2.1 Rationale and Precedent for the Purchases

The asset purchases were expected to support market functioning through multiple channels (see Logan, 2020b, for additional details). First, the purchases would alleviate pressure on intermediaries by absorbing some of the extraordinary Treasury and MBS sales, which could help restore two-way trading to the market and hence market liquidity. Second, the purchases were expected to reduce pricing dislocations, as the Fed tends to buy securities that are undervalued. Aside from these direct effects, the Fed's commitment to buying securities "in the amounts needed" might be expected to reduce selling by investors that did not need the cash at the time, but that might choose to sell to guard against the risk of market functioning worsening further.

Note that there is nothing uncommon about the Fed buying Treasuries and more recently agency MBS, but what was unusual was the speed and magnitude of the purchases and the motivation. The Fed has regularly conducted secondary market trades in Treasuries, and in recent years agency MBS, to manage the supply of reserves held by banks. Before the pandemic, the Fed was engaged in reserve management purchases of Treasury bills at a pace of \$60 billion per month. In addition, principal payments from agency debt and agency MBS--up to \$20 billion per month--were being reinvested in Treasuries (across security types), and principal payments above \$20 billion were being reinvested in agency MBS.

¹³ Note that our analysis and what we call market functioning purchases are limited to open market purchases of securities by the System Open Market Account, authorized under Section 14 of the Federal Reserve Act, and hence exclude securities acquired by the facilities using the Fed's emergency lending powers authorized under Section 13(3) of the Act.

There was also recent precedent for asset purchases in sizeable amounts with the Fed’s large-scale asset purchases (LSAPs) conducted between December 2008 and October 2014, although the earlier LSAPs were at a lesser speed and scale, and had lowering interest rates as a primary motivation. In the first LSAP program, the Fed purchased \$1.25 trillion of agency MBS and \$175 billion of agency debt securities “to reduce the cost and increase the availability of credit for the purchase of houses” (Board of Governors, 2008) and \$300 billion of Treasuries “to improve conditions in private credit markets” generally (Board of Governors, 2009).

Going back further, there are instances of the Fed purchasing securities to support Treasury market functioning. Garbade and Keane (2020) describe such episodes from 1939, 1958, and 1970, and track the origins of the Fed’s concern with, and responsibility for, an orderly market for Treasury securities to a 1936 FOMC meeting.

At a more general level, Fed officials have explained how ensuring liquid and smoothly functioning financial markets are essential roles for central banks. New York Fed President Williams, for example, explained how no private institution has the ability to provide liquidity at the speed or scale of the Fed and other central banks, and how the Fed was originally created to ensure the stability of the financial system (Williams, 2020). The market functioning purchases are one way the Fed provided liquidity, thereby promoting smooth market functioning and hence financial stability.

2.2 How the Purchases Worked

The Fed’s market functioning purchases were generally executed in a similar manner as past asset purchases. That said, their differing motivation led to differences in the speed and magnitude of the purchases, and changing operation terms over time.

Counterparties

The market functioning purchases were conducted with the primary dealers, as is typical for such “permanent” open market operations.¹⁴ Primary dealers are trading counterparties of the New York Fed in its implementation of monetary policy, as noted earlier. They are also key

¹⁴ Permanent open market operations involve outright purchases or sales of securities, whereas “temporary” open market operations involve short-term repurchase and reverse repurchase agreements. Note that some non-primary dealers were approved counterparties for the Fed’s agency CMBS purchases, as explained later.

intermediaries in financial markets, transacting with customers in their role as market makers. In the Fed's purchase operations, primary dealers are expected to submit offers for both themselves and their customers.

Execution Method

The Desk conducts secondary market purchases of Treasuries and agency MBS via FedTrade, its proprietary trading system.¹⁵ The purchases are conducted using multiple-price competitive auctions, with each dealer able to submit several offers on each security in an operation. For agency MBS, offers in FedTrade operations are evaluated based on their proximity to prevailing market prices at the auction close, whereas, for Treasuries, offers are evaluated on both their proximity to market prices and measures of relative value.

Securities Purchased

The Desk's market functioning purchases of Treasuries were primarily of nominal coupon securities (that is, notes and bonds) and Treasury Inflation-Protected Securities (TIPS).¹⁶ The investable universe included every available CUSIP within these security types with a few exceptions. For both security types, the Desk excluded securities in which the Fed owned 70 percent of the outstanding amount, and securities that were trading with heightened scarcity value in the repo market. For notes and bonds, the Desk further refrained from purchasing the most recently issued security, and securities with four weeks or less to maturity. For TIPS, the Desk refrained from purchasing securities with one year or less to maturity.

Agency MBS purchases were concentrated in recently produced coupons in 30- and 15-year fixed-rate MBS in the TBA market. The TBA market is highly liquid and is closely tied to primary mortgage rates because when borrowers lock in their mortgage rates, lenders often simultaneously short in the TBA market to hedge their interest rate risk, effectively offloading these mortgages

¹⁵ The Desk conducts agency MBS dollar roll transactions via Tradeweb, a commercial trading platform. Such transactions are executed through a competitive bidding process in line with standard market practices. Agency CMBS purchases were operationalized by Blackrock Financial Markets Advisory. See the Markets Group's [FAQs: Treasury Purchases](#) and [FAQs: Agency MBS Purchases](#) for additional information on the purchases.

¹⁶ The Desk conducted one operation in Treasury bills at the outset of market functioning purchases. There were no purchases of Treasury floating rate notes. Planned purchase amounts and schedules for Treasury securities are available on the Markets Group's [Treasury Securities Operational Details](#) and [Treasury Security Operations](#) pages. Analogous information for agency MBS purchases is available on the [Tentative Outright Agency Mortgage-Backed Securities Operation Schedule](#) and [Agency Mortgage-Backed Securities Operations](#) pages.

before they are originated (Fuster, Lo, and Willen, 2017). It follows then that liquidity and pricing in the TBA market crucially affect homeowners' mortgage rates and credit supply.

Purchase Schedule, Frequency, and Amounts

At the start of the market functioning purchases in March 2020, operation terms were adjusted as needed to foster smooth market functioning and efficient and effective policy implementation ([FAQs: Treasury Purchases, April 17, 2020](#)). Initially, Treasury operations for the next business day were announced around 4:30 pm and provided the time, security sector/type, and planned purchase amounts. By mid-April 2020, operation schedules were provided for the coming week and by mid-June 2020 for the coming half month. MBS operation schedules were provided for the coming week between late March and early June 2020, and otherwise for the coming half month, although the schedules were updated on a daily or near-daily basis from mid-March to mid-April. Treasury operations occurred in one of five maturity buckets for nominal coupons (0-2.25 years, 2.25-4.5 years, 4.5-7 years, 7-10 years, and 20-30 years), or one of two for TIPS (1-7.5 years and 7.5-30 years).¹⁷ Agency MBS operations occurred in one of three security types: 15-year UMBS, 30-year UMBS, and 30-year Ginnie Mae MBS.

Purchase amounts started at roughly \$40 billion per day in Treasuries, but quickly ramped up to about \$70 billion per day, where they remained for two weeks between March 19 and April 1 (Chart 15). Agency MBS purchase amounts started at about \$5 billion per day and quickly topped out at \$41 billion on March 27 (Chart 16). As market functioning improved, daily purchase amounts declined, stabilizing at a pace of around \$80 billion per month (roughly \$4 billion per day, on average) for Treasuries and about \$40 billion for agency MBS, net of reinvestments (or roughly \$2 billion per day, on average).

Variation in daily purchase amounts is explained by both variation in operation frequency as well as operation size. The number of Treasury operations per day topped out at seven in late March and early April, but varied between 0 and 2 for every day in 2020 after April 17. Average amount purchased per operation was just over \$10 billion in late March (defined as the last five

¹⁷ The maturity buckets differed before the market functioning purchases started in March 2020 and were expanded to six for nominal coupons in May 2021.

trading days of the month), about \$6 billion in late April, and roughly \$3 billion in late May. Across all Treasury operations in 2020, the average amount purchased was \$6.5 billion (Table 1).

Table 1: Descriptive Statistics on Market-Functioning Purchase Operations in 2020

| | Treasuries | Agency MBS | Agency CMBS |
|-------------------------|------------------------|-----------------------|----------------------|
| Number of operations | 330 | 539 | 46 |
| Planned purchase amount | 6.65 (1.00, 25.00) | 3.02 (0.67, 20.00) | 0.55 (0.25, 2.00) |
| Amount submitted | 15.07 (1.42, 56.82) | 6.12 (1.54, 27.17) | 1.08 (0.04, 6.48) |
| Amount accepted | 6.51 (0.70, 25.00) | 2.71 (0.67, 17.55) | 0.22 (0.00, 2.03) |
| Offer-to-cover | 2.34 (0.59, 5.75) | 2.45 (0.26, 5.50) | 1.69 (0.07, 5.62) |

Source: Authors' calculations, based on data from the Federal Reserve Bank of New York.

Notes: The table reports operation statistics for Federal Reserve purchases of Treasury securities, agency mortgage-backed securities (MBS), and agency commercial mortgage-backed securities (CMBS) between March 13, 2020 and December 31, 2020 (excluding small value exercises). Offer-to-cover is the ratio of amount submitted to the planned purchase amount for a given operation. For all variables except the number of operations, averages are reported with minimums and maximums in parentheses. Planned purchase amount, amount submitted, and amount accepted are in billions of dollars, par value.

For agency MBS, the number of operations per day topped out at six in late March and early April, and was then 2-3 on almost every day in 2020 after April 17. Amount purchased per operation averaged nearly \$7 billion in late March, just over \$3 billion in late April, and just over \$2 billion in late May. Across all MBS operations in 2020, the average purchase amount was \$2.7 billion (Table 1). Agency CMBS operations were much less frequent, with two operations on April 9 and at most one any other day. Agency CMBS operation sizes maxed out at \$2.0 billion on April 7.

Amounts submitted in the operations between March 13, 2020 and the end of the year averaged about 2½ times the planned purchase amounts for both Treasuries and agency MBS and somewhat less for agency CMBS (Table 1). Such offer-to-cover ratios were less than one (that is, amounts submitted were less than planned purchase amounts) for 7 of the 330 Treasury operations, 20 of the 539 agency MBS operations, and 17 of the 46 CMBS operations. All of these low coverage Treasury and agency MBS operations occurred between March 20 and April 9.

2.3 Novel Aspects of the Purchases

The motivation for the market-functioning purchases led to several innovations in how they were conducted, aside from their speed and scale. In particular, the variation in the pace of purchases and the distribution of purchases across sectors, discussed above, were based on both observable measures of market functioning as well as judgement (Logan, 2020b). Varying market conditions led to further innovations in the particular securities purchased and in the settlement timing of the purchases.

Measures of Market Functioning

The metrics used to inform the market functioning purchases fell into four categories (Logan, 2020b and Federal Reserve Bank of New York, 2021, p. 25). The first included direct measures of liquidity, such as bid-ask spreads, price impact coefficients, and market depth, which reflect market participants' ability to transact at reasonable costs. The second included direct measures of relative value, such as the Treasury cash-futures basis, on-the-run spreads, and MBS-Treasury yield spreads, which indicate whether closely related securities are priced similarly, and whether arbitrage between markets is working well.

The remaining categories contained indirect metrics that may reveal forces that can lead to breakdowns of liquidity and efficient pricing. The third category thus included measures of trading pressure, including data on customer-initiated transactions, holdings of foreign official accounts, and dealer inventories, which can suggest imbalances between liquidity demand and liquidity supply. The last category included the results of the Desk's open market operations, such as offer-to-cover ratios, which can provide information market participants' desire to sell securities or other challenges to market functioning.

Short Settlement MBS Purchases

Another innovation in the 2020 market functioning purchases was the adjustment of settlement timing for some agency MBS operations so as to more quickly influence market conditions (Logan, 2020b). Historically, the Fed followed the TBA schedule for its purchases, with a monthly settlement date, usually in the middle of the month. A potential downside of the TBA schedule is that the Fed and its primary dealer counterparties need to wait until the next monthly settlement date to exchange cash for securities. During the March 2020 dash for cash, many sellers

of securities could not wait so long (Chen et al., 2020).¹⁸ Evidence of these cash needs is the reduced pay-up at the time, as selling pressure disproportionately went to the SP market, driving down SP prices relative to TBA prices (Chart 9).

To address the surge in demand for cash (Federal Reserve Bank of New York, 2021), the Fed made agency MBS purchases that settled within 2-3 business days between March 19 and March 27 (Chart 16). With these purchases, dealers received cash faster for their securities and could use the freed balance sheet space to absorb more sales from customers. Comparing prices from the short settlement trades and the conventional trades for the same security on the same trading date, we see that dealers were willing to accept large discounts for short settlement trades (Chart 17), suggesting both large price dislocations and strong demand for these innovative short settlement offerings (also see Chen, et al., 2020).

CMBS Purchases

Another innovative feature of the market functioning purchases is that for the first time the Fed purchased agency CMBS. Agency CMBS are securitizations of loans for commercial real estate, primarily multifamily residential properties, such as apartment buildings. As with single-family mortgages, Fannie Mae, Freddie Mac, and Ginnie Mae package these loans into securities and guarantee principal and interest payments. Broker dealers facilitate selling the securities to investors. As of July 2020, agency CMBS outstanding totaled around \$750 billion, accounting for 47 percent of the \$1.6 trillion in total multifamily mortgage debt outstanding (Park, Gouny, and Liu, 2020).

In March 2020, conditions in the agency CMBS market became severely disrupted amidst broad financial market stress and concern about the effects of the pandemic on commercial real estate in particular. New issuance of agency CMBS stalled, threatening to reduce credit availability in the multifamily housing sector. The market functioning purchases for agency CMBS began on March 27, following the FOMC's direction to the Desk on March 23. The purchases relied on a different execution method and a broader set of counterparties than purchases of Treasuries and

¹⁸ Typically, the costs associated with monthly settlement schedule are minimal. Interest rate risk is transferred with the execution of a trade. The exchange of securities for cash does not occur until later, but the seller of securities may not need the cash or it may be able to cheaply and easily borrow funds against the sold securities between the trade and settlement dates. It follows that the logistical benefits of monthly settlement usually exceed the costs and that the Fed's purchases of agency MBS typically follow the monthly settlement schedule.

other agency MBS, reflecting the novelty of the Fed’s purchases and the unique aspects of the market.¹⁹ While purchases of agency CMBS in 2020 were relatively small, about \$10 billion in total or under 2% of the total outstanding, both primary market issuance and secondary market metrics largely returned to normal by April 2020.

Cheapest-to-Deliver Treasury Purchases

Another departure from past purchase programs is that the Treasury operations between March 13, 2020 and April 17, 2020 included securities that were cheapest-to-deliver (CTD) into futures contracts. This was done to support smooth market functioning in these securities (and off-the-run securities more broadly) amid heightened volatility and demand for liquidity ([FAQs: Treasury Purchases, April 17, 2020](#)). Dislocations had arisen in the relative value relationship between the futures contracts and the CTD securities. The dislocations reflected the wider dash for cash as well as large-scale liquidations of levered relative value positions, which reportedly contributed to the increase in dealer positions (Schrimpf, Shin, and Sushko, 2020; Barth and Kahn, 2021).

2.4 Challenges, Limitations, and Drawbacks of Market Functioning Purchases

While there were sound reasons to think the Fed’s market functioning purchases would achieve their purpose, such purchases do not come without challenges, limitations, and drawbacks.

First, as with most policy responses, market functioning purchases require proper diagnosis of the problem. That is, in 2020, the problem that positions were building up on dealer balance sheets due to customer selling and that central bank purchases could help restore balance to the market and enable dealers to fulfill their intermediation role. If the disruptions had arisen for other reasons, or if dealers were not willing to intermediate flows between customers and the central bank, then such purchases could have been counterproductive and exacerbated market dysfunction.

¹⁹ The New York Fed retained BlackRock Financial Markets Advisory as a third-party vendor to operationalize agency CMBS purchases and transact with approved counterparties on behalf of the SOMA. [Approved counterparties](#) included a subset of the primary dealers as well as other dealers who applied for and received approval. On September 4, 2020 the New York Fed [announced](#) an expansion of approved counterparties in order to broaden access to the operations and increase the New York Fed’s operational capacity and reach into the agency CMBS market. See [FAQs: Agency Commercial Mortgage-Backed Securities](#) for additional details.

A related challenge is that it may be difficult for a central bank to calibrate the quantity of securities to be purchased. As an example, the Fed has access to timely information on dealers' trades with customers via Trade Reporting and Compliance Engine (TRACE) data of the Financial Industry Regulatory Authority (FINRA), but the data are incomplete and do not reflect trades that customers may have wanted to execute but could not.²⁰ The data also do not reveal the quantity of customer flows that dealers can absorb themselves without adversely affecting market functioning. Moreover, market functioning has multiple dimensions, some of which can be difficult to measure. Proper calibration arises with any policy response, but is particularly difficult in an uncertain and fast-changing environment.

A possible limitation of market functioning purchases is the reliance on primary dealer counterparties. There are important reasons the Fed and other central banks have primary dealer counterparties with various requirements and expectations. In March 2020, however, as customer flows overwhelmed dealers' capacity to intermediate customer flows (Duffie, 2020), there may have been advantages to transacting directly with customers and additional dealers. Some of the proposals to promote a more resilient market structure suggest that Fed liquidity provision be accessible to a broader range of counterparties (e.g., Liang and Parkinson, 2020; Brookings, 2021; and Group of 30, 2021), albeit for repos and not outright transactions.

A potential drawback of market functioning purchases is that they have an expansionary effect on the economy by lowering yields (as with the LSAPS, as discussed in Gagnon, et al., 2011). That is, while the market functioning purchases were conducted for somewhat different reasons than the LSAPs of the preceding years, they could still be expected to have similar effects. During the pandemic, this ancillary effect was a positive one given the risks to the economy. Moreover, the rationale for the purchases evolved over time to be closer to that of the earlier LSAPs as discussed below. However, it is possible that there could be a future episode of market dysfunction in which the expansionary effect of such purchases would be contrary to the desired monetary policy stance (Hauser, 2021, makes a similar point).

²⁰While dealers report their trades to TRACE, entities that are not FINRA-member dealers, such as banks, do not report their trades. In October 2021, the Fed adopted a proposal to implement reporting requirements on trading in Treasuries, agency debt securities, and agency MBS for certain depository institutions, thereby expanding the coverage of reporting.

Another potential drawback of market functioning purchases is that they increase the size of the central bank's balance sheet. The Fed's assets grew from \$4.3 trillion on March 10, 2020 to \$7.4 trillion on December 30, 2020, with 93% of this increase explained by the Fed's increased holdings of Treasuries and agency MBS. A large central bank balance sheet, excessive asset purchases, and/or substantial government security purchases in particular are sometimes viewed as overly intrusive in financial markets, excessively risky, and/or a precursor to excessive inflation.²¹ Moreover, shrinking the balance sheet takes time and poses communication challenges.

Lastly, a possible drawback of any central bank action during a crisis, including the market-functioning purchases, is that it may introduce moral hazard. That is, market participants may lack sufficient incentive to protect themselves against the risks associated with their actions, or may take greater risks, if they don't bear the full consequences. The Financial Stability Board (2020) thus argues that the aggressive central bank actions to restore market functioning in 2020 "could lead to moral hazard issues in the future, to the extent that markets do not fully internalise their own liquidity risk in anticipation of future central bank interventions in times of stress." Kovner and Martin (2020), in contrast, suggest moral hazard concerns may be mitigated because the pandemic was not expected, so the interventions did not reward firms that took excess risk, and because systemic shocks are rare, so official sector support in response to them is unlikely to have much effect on incentives.

3. THE PURCHASES' EFFECTS AND THEIR EVOLUTION

3.1 Effects of the Purchases

We assess the effects of the Fed's purchases by relating their initiation and scaling up to the evolution of various market functioning measures. We focus on market functioning given the policy's stated aim, although other effects are also important (Vissing-Jorgensen, 2021, for example, assesses the effects on yields). To be sure, attributing causality to the purchases is challenging. The purchases occurred amidst the rapidly evolving pandemic and numerous resulting policy actions,

²¹ See, for example, Michel, Norbert, 2017, "It's Time for the Fed to Shrink its Balance Sheet", *Forbes*, May 12, and Derby, Michael S., 2020, "Derby's Take: Powell Says Fed is not Monetizing Treasury Debt Surge," *Wall Street Journal*, June 17.

both fiscal and monetary. Moreover, market functioning has multiple aspects, some of which are hard to quantify. In addition, market functioning metrics are not necessarily forward looking in the same way as asset prices, so that a credible announcement to support market functioning could reasonably have delayed effects (e.g., because the announcement breeds uncertainty about asset values that initially worsens functioning).

The evidence is supportive of the purchases being effective at promoting market functioning. Many Treasury market liquidity measures as well as Treasury volatility, reached their nadir Friday, March 13 (Charts 1, 3, 4, and 5). The Fed acquired significant Treasuries that day as it moved forward its reserve management and other purchases, but the FOMC announcement of market functioning purchases (and cut in the fed funds rate to the zero lower bound) did not come until Sunday, March 15. Liquidity conditions improved notably the next day from the preceding Friday, with volatility declining.

The next notable improvement in Treasury market functioning occurred Friday, March 20, following the ramping up of Treasury purchases the preceding day to \$68 billion. That day saw a narrowing of bid-ask spreads, increased market depth, lower price impact, and reduced volatility. The two-and five-year on-the-run/off-the-run spreads also declined sharply (and the ten-year spread modestly) that day (Chart 8). Treasury yields, which had continued increasing after the initiation of market functioning purchases, declined modestly on March 19 and more sharply on March 20, which Vissing-Jorgensen (2021) attributes to the higher pace of purchases.

Despite some improvements, Treasury market functioning remained highly strained through March 23, when the Fed dropped explicit quantity limits on its total purchases. Liquidity improved notably the next day and volatility plunged. Liquidity continued to improve steadily for the next couple weeks, with volatility declining, even as the Fed pared back its purchases from their highest levels. By the week of April 6-10, some liquidity metrics were close to normal, with bid-ask spreads for recently issued notes and bonds commensurate with usual levels.²² Other metrics suggested

²² Bid-ask spreads remained unusually wide for an extended period for off-the-run securities as shown in Logan (2020a) and Clarida, Duygan-Bump, and Scotti (2021).

continued illiquidity relative to the levels of early 2020, but liquidity continued to improve over subsequent weeks and months.²³

Agency MBS liquidity metrics broadly followed a similar pattern. Bid-ask spreads and price impact for 3% UMBS deteriorated on March 12, before slightly improving after the Treasury purchases on March 13 and the FOMC announcement on March 15 (Charts 6 and 7). However, liquidity measures further deteriorated the second half of the week of March 15. Bid-ask spreads and price impact reached their peaks on March 20 and March 19 respectively. After the Fed committed to market functioning purchases “in the amounts needed” on March 23, market conditions gradually improved. Bid-ask spreads and price impact improved notably by the week of April 6-10, followed by further improvements in the weeks and months that followed.

Price dislocations in the agency MBS market largely moved in line with the liquidity measures. The MBS-Treasury basis and pay-up reached their worst levels between the first market functioning purchase announcement on March 15 and the second on March 23, but notably improved after March 23 (Charts 9 and 10). Short settlement discounts (Chart 17), which we interpret as a measure of dealer balance sheet costs, improved on March 23, but remained large. The discount continued to narrow over the next couple days and was close to 0 on March 26 and March 27, which may explain the Fed’s return to the usual TBA settlement schedule for its purchases the following Monday.

3.2 From Supporting to Sustaining and Beyond

As market conditions improved, Fed purchases were quickly scaled back, dropping from a daily average of \$104 billion in late March, to \$18 billion in late April, and \$9.5 billion in late May. By late May, purchases bottomed out at the level they would persist at through the rest of 2020 (Chart 18) and into 2021, and at a level commensurate with that of the earlier LSAP programs. This occurred as the FOMC’s commitment to asset purchases “in the amounts needed” remained, with the April FOMC statement using the same wording to characterize the purchases as the March 23 statement that preceded it.

²³ Interestingly, gross customer sales of off-the-run notes and bonds peaked March 23, when the Fed dropped explicit quantity limits on its total purchases (Chart 11). Nonetheless, sales remained extremely high into early April, and higher-than-usual through mid-April.

By the time of the June 2020 FOMC meeting, the pace of purchases had declined to roughly \$80 billion per month in Treasuries and about \$40 billion per month in agency MBS, net of reinvestments. The FOMC announced in June (and again in July) that it would increase its holdings of Treasuries and agency MBS “at least at the current pace to sustain smooth market functioning, thereby fostering effective transmission of monetary policy to broader financial conditions” (Board of Governors, 2020c). The change from “supporting” to “sustaining” thus acknowledged the improvement in market functioning that had already occurred. Moreover, the new guidance about purchase quantities was accompanied by monthly purchase amounts (that were consistent with the pace of purchases at the time) and semi-monthly purchase schedules (Logan, 2020b).

After the September and November 2020 meetings the FOMC announced it would increase its holdings of Treasuries and agency MBS “at least at the current pace to sustain smooth market functioning and help foster accommodative financial conditions” (Board of Governors, 2020d). The new guidance thus acknowledged what Chair Powell had been saying for some time – that the purchases had a broader benefit than just promoting market functioning.²⁴

The ongoing pace of asset purchases was formalized in the FOMC’s December 2020 meeting statement in which it directed the New York Fed’s Trading Desk to increase its holdings of Treasuries by at least \$80 billion per month and of agency MBS by at least \$40 billion per month “until substantial further progress has been made toward the Committee’s maximum employment and price stability goals,” while noting that “these asset purchases help foster smooth market functioning and accommodative financial conditions” (Board of Governors, 2020e). Similar wording appeared in FOMC statements through September 2021.

In light of the economy’s further progress toward the committee’s goals, the FOMC decided at its November 2021 meeting that it would begin reducing the monthly pace of its net asset purchases, by \$10 billion for Treasuries and \$5 billion for agency MBS. It then decided at its December 2021 meeting to reduce the monthly pace of its net asset purchases by \$20 billion for Treasuries and \$10 billion for agency MBS given inflation developments and further improvement in the labor market.

²⁴ See, for example, the transcripts of Chair Powell’s press conferences after the April, June, and July 2020 FOMC meetings.

4. CONCLUSION

The COVID-19 pandemic had extraordinary effects on U.S. financial markets whereby investors sought to sell their safest and most liquid securities to raise cash. The selling overwhelmed dealers' capacity to absorb the flows and contributed to the worst market disruptions since the global financial crisis, amidst the worst recession since World War II. The Federal Reserve took steps to address the disruptions, including the initiation of purchases of Treasuries and agency MBS to promote smooth functioning of these critical markets. The purchases seem to have been effective with market conditions rapidly improving, and the asset purchases were scaled back accordingly.

The market functioning purchases were novel in terms of their speed and scale and their innovativeness. In terms of speed and scale, the purchases quickly reached over \$100 billion per day, dwarfing the pace of asset purchases seen with the LSAPs during and after the global financial crisis. In terms of innovativeness, the Fed varied the pace and distribution of purchases based on observable measures of market functioning, reflecting the particular motivation for the purchases. It also engaged in "short settlement" MBS operations, through which the trades settled much sooner than market convention prescribed, allowing dealers to obtain cash for their MBS sales much more speedily than is typical. The Fed also for the first time purchased agency CMBS to promote the smooth functioning of this important market.

At the same time, the market functioning purchases were not unique, relying on familiar tools, specific precedent, and general principles. First, the Fed relied on a tool (open market trading in Treasuries and agency MBS) that it commonly uses (albeit more recently in the case of agency MBS) in the implementation of monetary policy. Moreover, the Fed purchased such securities in large quantities during and after the global financial crisis (albeit for different purposes) and had purchased Treasury securities to support market functioning in episodes before that. More generally, the purchases provided liquidity, which is a classic central bank function, thereby promoting financial stability, a purpose for which the Fed was created.

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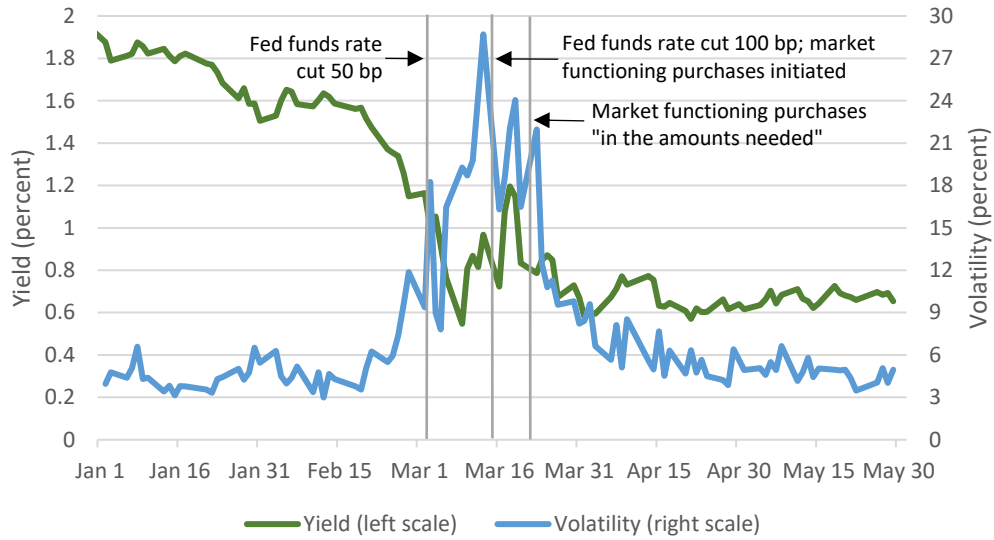
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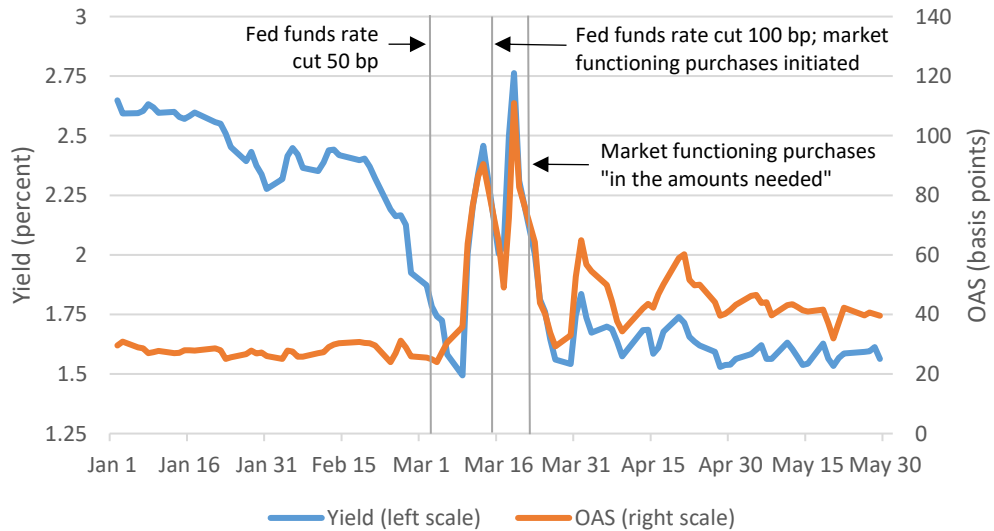
Chart 1: Treasury Yield and Price Volatility in Early 2020



Source: Authors’ calculations, based on data from BrokerTec.

Notes: The chart plots the closing yield and realized price volatility by day for the on-the-run ten-year note from January 1 to May 31, 2020. Realized price volatility is calculated by summing squared five-minute returns (log changes in midpoint prices) for New York trading hours (7:30 a.m. – 5 p.m.), annualizing by multiplying by 252, and then taking the square root.

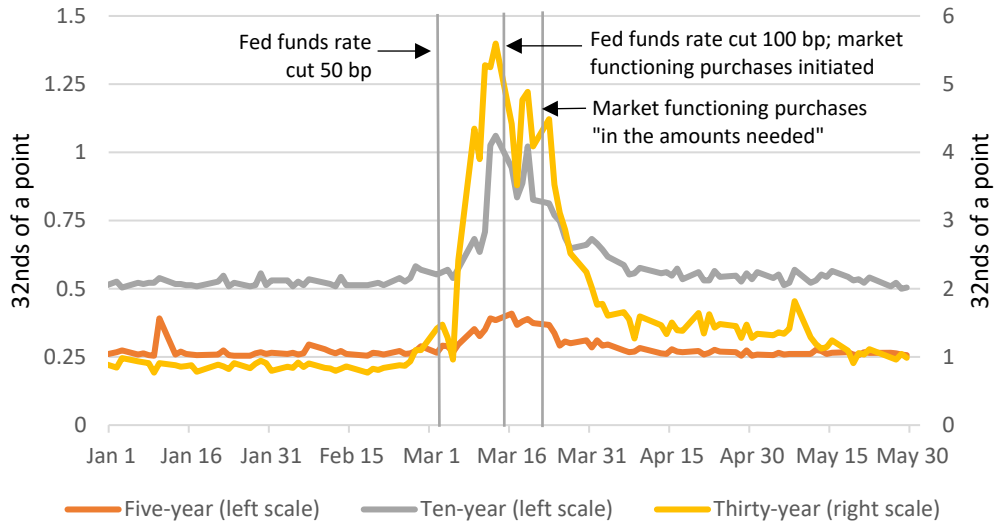
Chart 2: Agency MBS Yield and Option-Adjusted Spread in Early 2020



Source: JP Morgan Markets.

Notes: The chart plots the yield on 30-year current coupon UMBS and the option-adjusted spread (OAS) for such securities by day from January 1 to May 31, 2020.

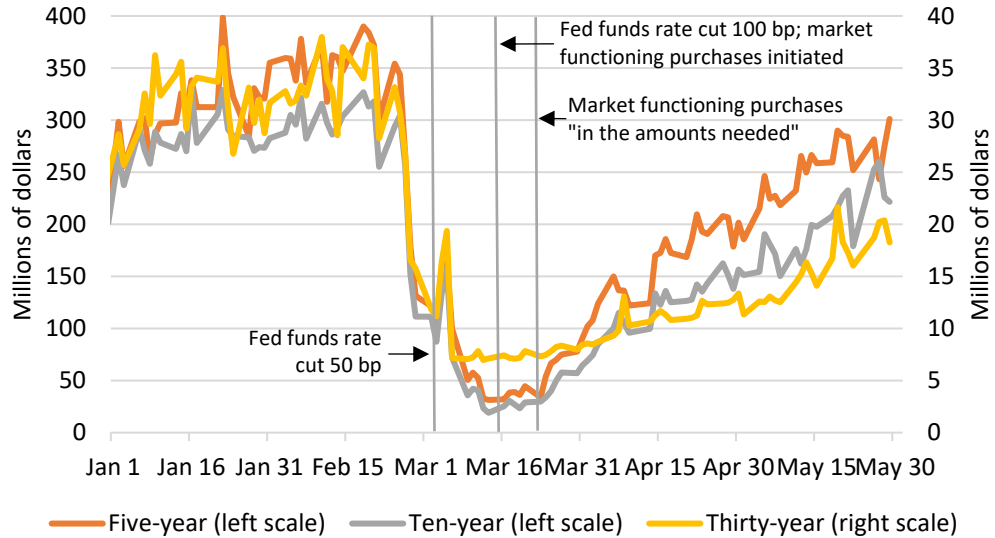
Chart 3: Treasury Security Bid-Ask Spreads



Source: Authors' calculations, based on data from BrokerTec.

Notes: The chart plots average daily quoted bid-ask spreads for the on-the-run five-, ten-, and thirty-year securities in the interdealer market from January 1 to May 31, 2020. Spreads are measured in 32nds of a point, where a point equals one percent of par.

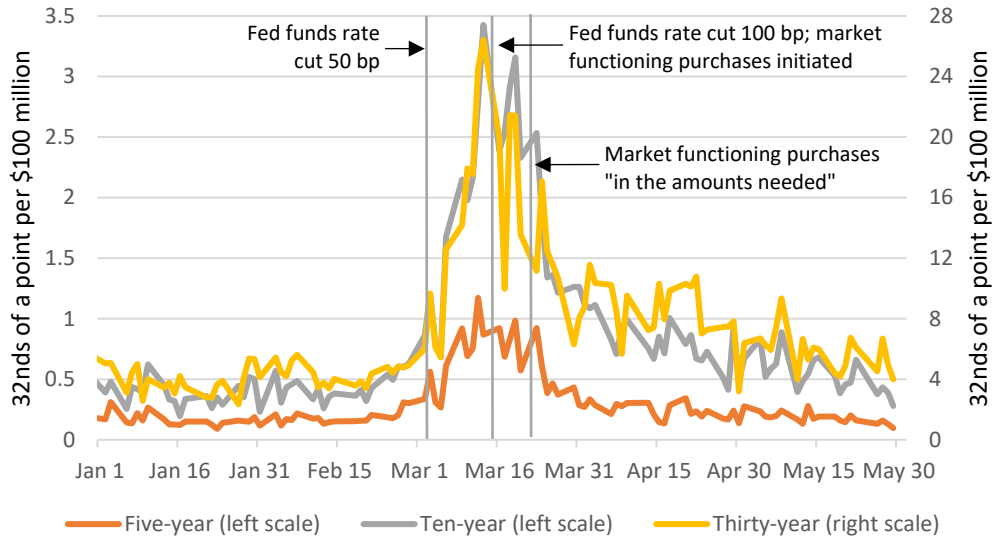
Chart 4: Treasury Security Order Book Depth



Source: Authors' calculations, based on data from BrokerTec.

Notes: The chart plots average daily depth for the on-the-run five-, ten-, and thirty-year securities in the interdealer market from January 1 to May 31, 2020. Data are for order book depth at the inside five tiers, averaged across the bid and offer sides. Depth is measured in millions of dollars par.

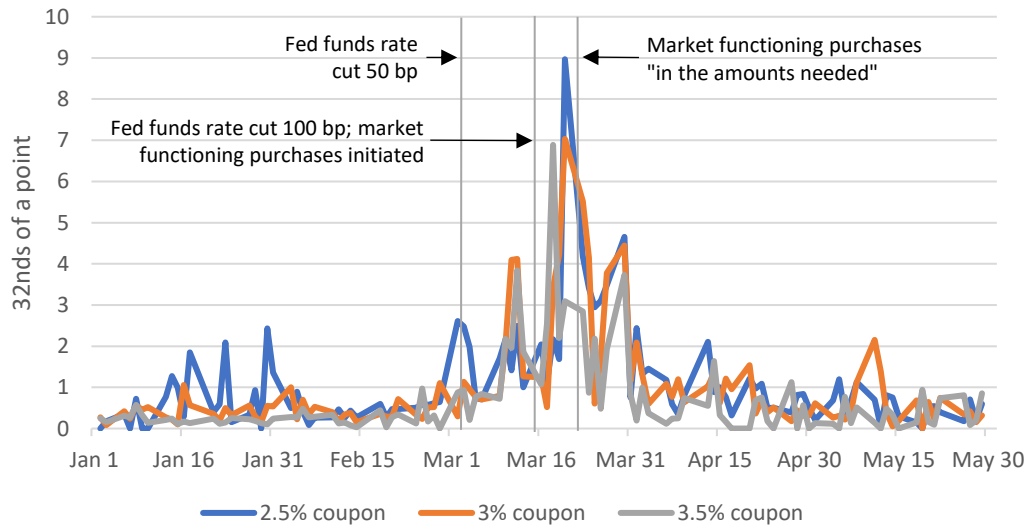
Chart 5: Treasury Security Price Impact



Source: Authors' calculations, based on data from BrokerTec.

Notes: The chart plots slope coefficients from daily regressions of one-minute price changes on one-minute net order flow (buyer-initiated trading volume less seller-initiated trading volume) for the indicated on-the-run securities in the interdealer market from January 1 to May 31, 2020. Price impact is measured in 32nds of a point per \$100 million, where a point equals one percent of par.

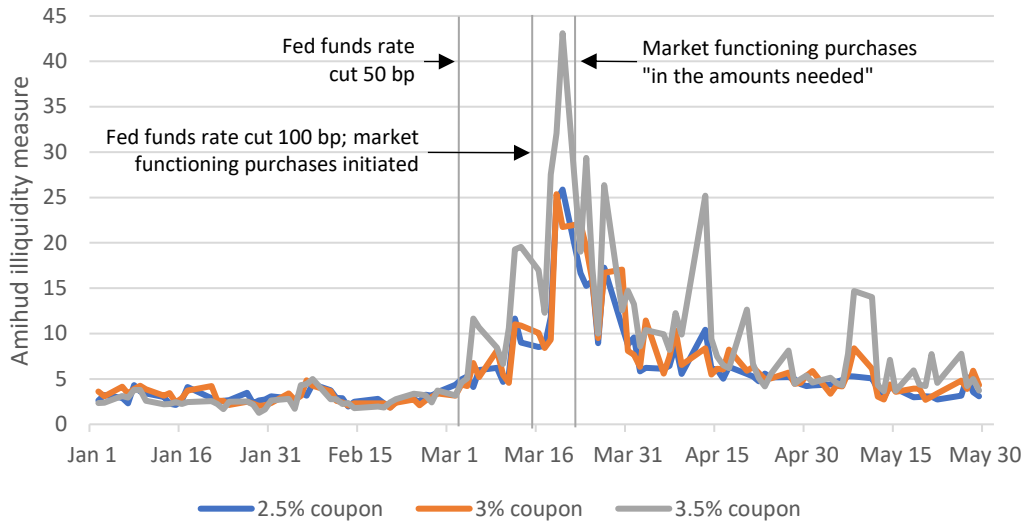
Chart 6: Agency MBS Bid-Ask Spreads



Source: Authors' calculations, based on data from FINRA TRACE.

Notes: The chart plots average daily effective bid-ask spreads for 30-year 2.5%, 3%, and 3.5% coupon UMBS in the TBA market from January 1 to May 31, 2020. Spreads are calculated for each coupon as dealers' volume-weighted average sell price minus dealers' volume-weighted average buy price for dealer trades with customers.

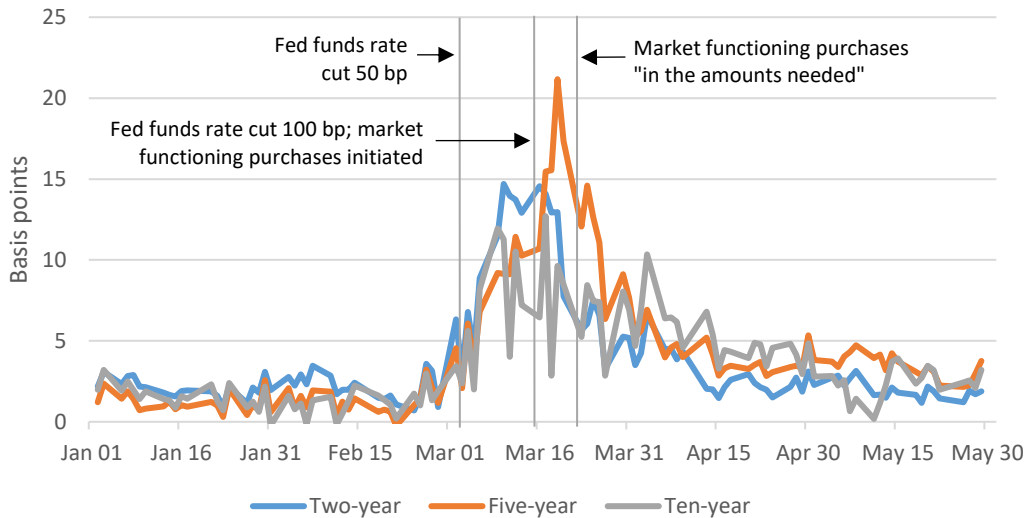
Chart 7: Agency MBS Price Impact



Source: Authors' calculations, based on data from FINRA TRACE.

Notes: The chart plots average daily Amihud (2002) price impact measures for 30-year 2.5%, 3%, and 3.5% UMBS in the TBA market from January 1 to May 31, 2020. The measures are calculated for each coupon as the absolute value of its daily return divided by its daily trading volume. Daily returns are computed from daily volume-weighted average prices and daily volume is computed as the sum of dealer-to-customer activity plus one half of reported dealer-to-dealer activity (to avoid double-counting).

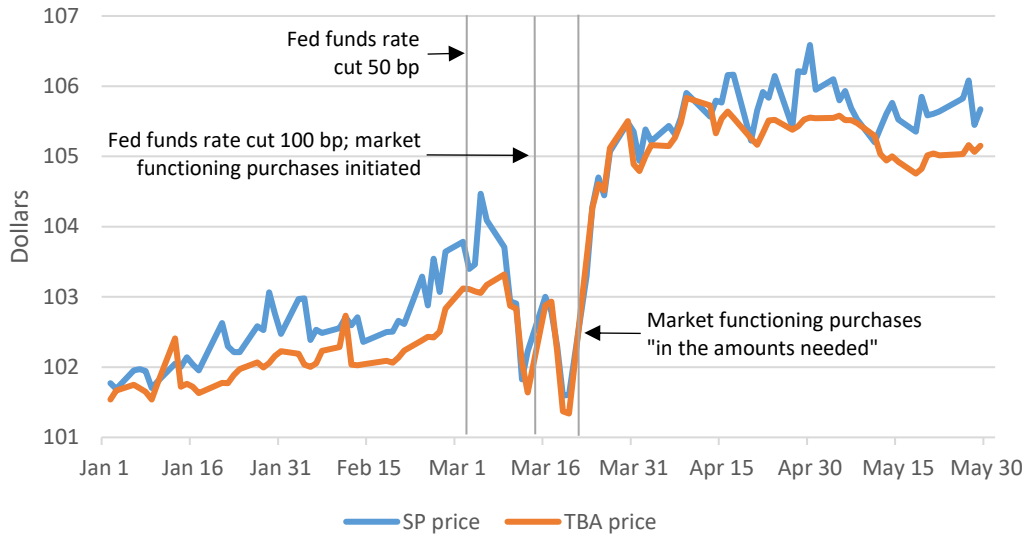
Chart 8: On-the-Run/Off-the-Run Treasury Spreads



Source: Authors' calculations, based on data from BrokerTec.

Notes: The chart plots on-the-run/off-the-run spreads for the two-, five-, and ten-year notes by day from January 1 to May 31, 2020. The spreads are calculated (using parameters from the Nelson-Siegel-Svensson model of Gurkaynak, Sack, and Wright (2007)) as the yields of hypothetical securities with the same cash flows as the on-the-run two-, five-, and ten-year notes less the actual yields of the notes.

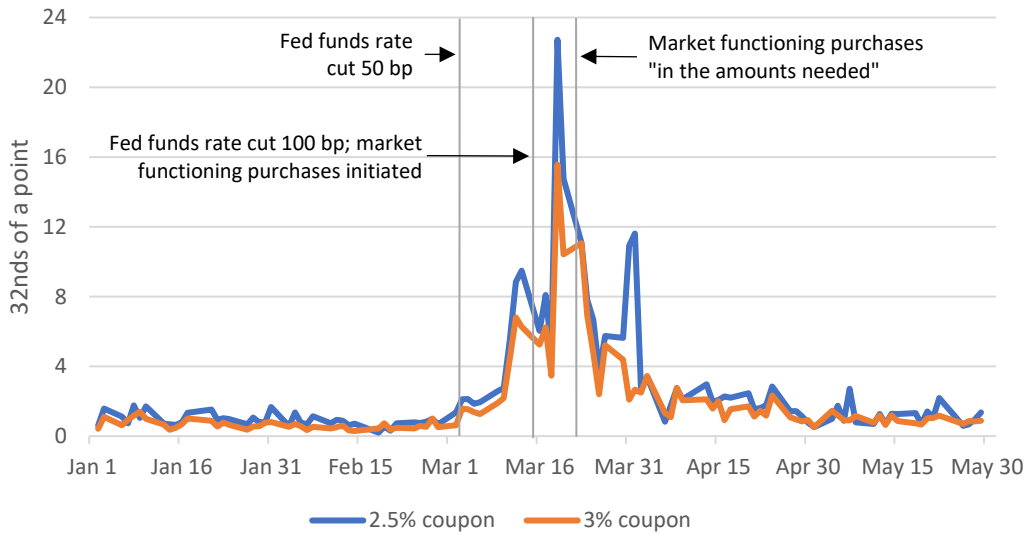
Chart 9: Specified Pool and TBA Prices for 3% UMBS



Source: Authors' calculation, based on FINRA TRACE data.

Notes: The chart plots the average daily price for 30-year 3% UMBS in the TBA market and the average daily price for TBA-eligible 30-year 3% UMBS in the specified pool (SP) market. Price is in dollars per \$100 par.

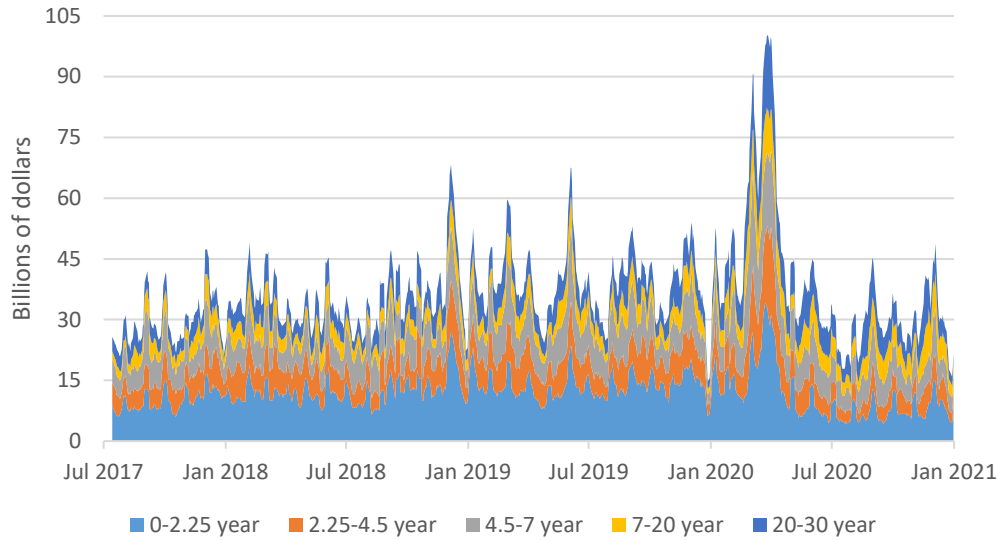
Chart 10: Agency MBS Basis Volatility



Source: Authors' calculations, based on data from Citi Velocity.

Note: The chart plots the daily standard deviation of hourly changes in the 30-year UMBS-5-year Treasury basis for the 2.5% and 3% coupons in the TBA market from January 1 to May 31, 2020.

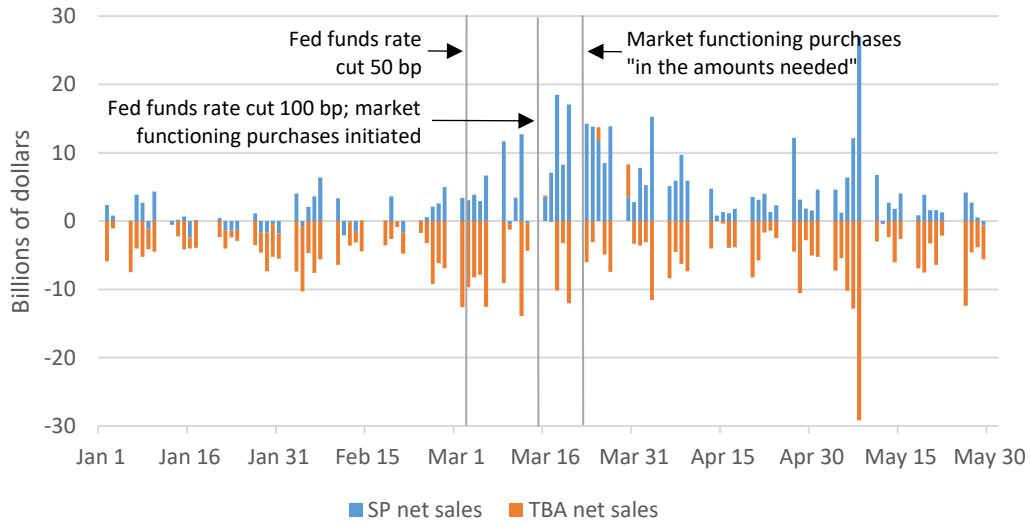
Chart 11: Customer Sales of Off-the-Run Treasury Notes and Bonds



Source: Authors’ calculations, based on FINRA TRACE data.

Note: The chart plots five-day moving averages of gross daily customer sales to dealers of off-the-run Treasury notes and bonds from July 10, 2017 (when Treasury TRACE reporting began) to December 31, 2020. Sales are measured in billions of dollars par.

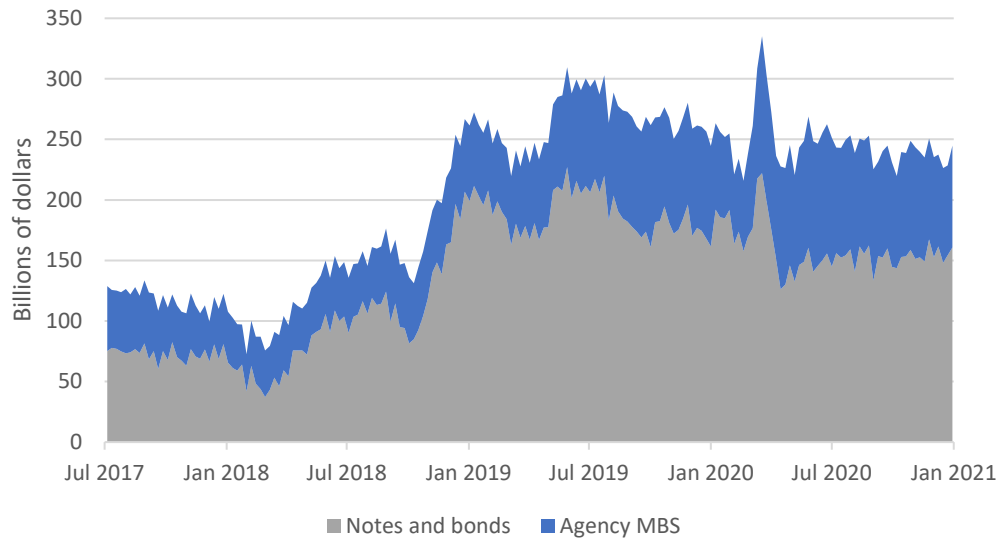
Chart 12: Customer Sales of Agency MBS



Source: Authors’ calculations, based on FINRA TRACE data.

Notes: The chart plots net customer sales to dealers of Fannie Mae and Freddie Mac mortgage-backed securities (MBS) in the SP and TBA markets by day from January 1 to May 31, 2020. Positive (negative) numbers imply net customer sales to (purchases from) dealers. Quantities are measured in billions of dollars par.

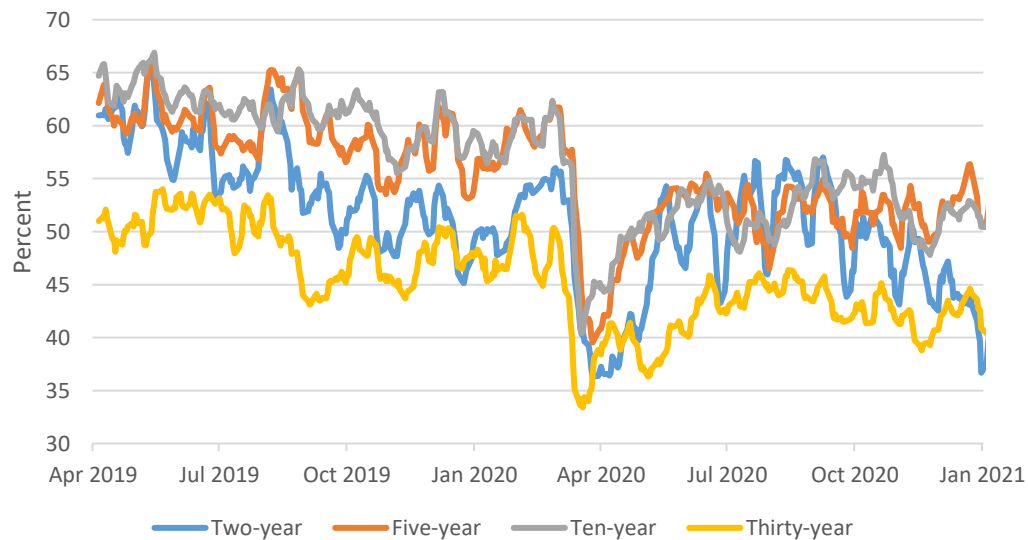
Chart 13: Primary Dealer Positions in Treasury Notes and Bonds and Agency MBS



Source: Authors’ calculations, based on data from the FR 2004A Weekly Report of Dealer Positions.

Note: The chart plots primary dealers’ aggregate net positions in Treasury notes and bonds, and agency mortgage-backed securities (MBS) from the week ending July 5, 2017 to the week ending December 29, 2020.

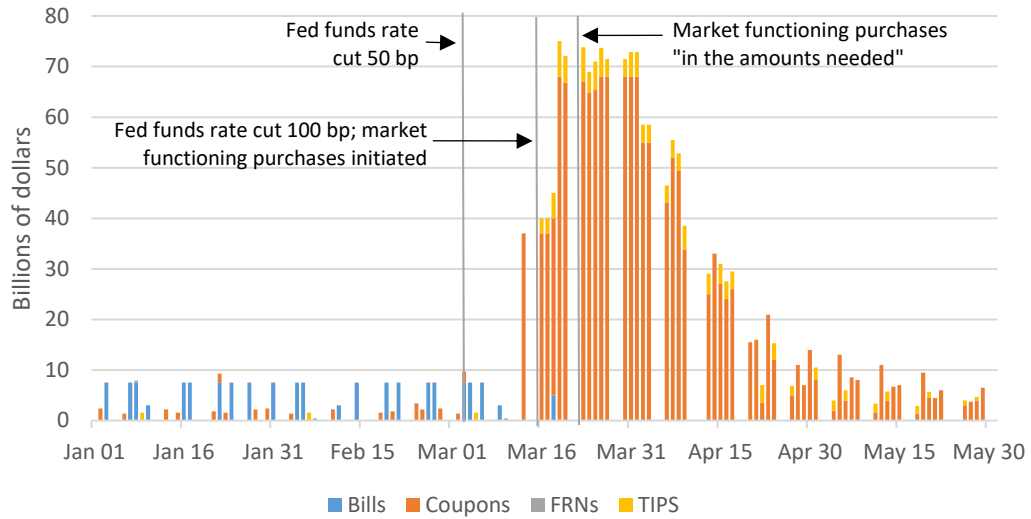
Chart 14: PTFs’ Treasury Security Trading Volume Shares on Electronic IDB Platforms



Source: Authors’ calculations, based on FINRA TRACE data.

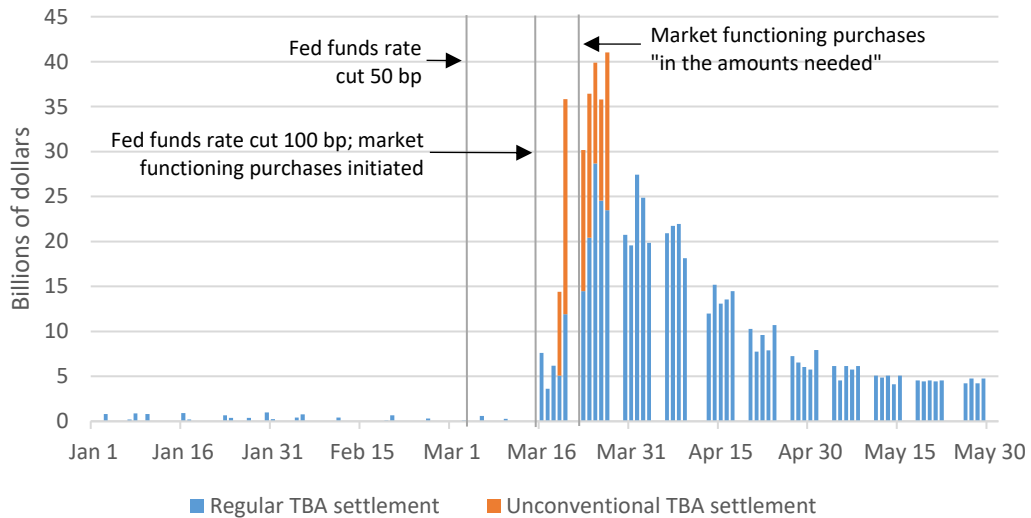
Notes: The chart plots five-day moving averages of principal trading firms’ (PTFs’) shares of Treasury security trading volume on electronic interdealer broker (IDB) platforms from April 1, 2019 (when such data on PTFs’ activity became available) to December 31, 2020. All activity on electronic IDBs involves notes and bonds, with nearly all activity attributable to the on-the-run notes and bonds in particular.

Chart 15: Open Market Purchases of Treasuries



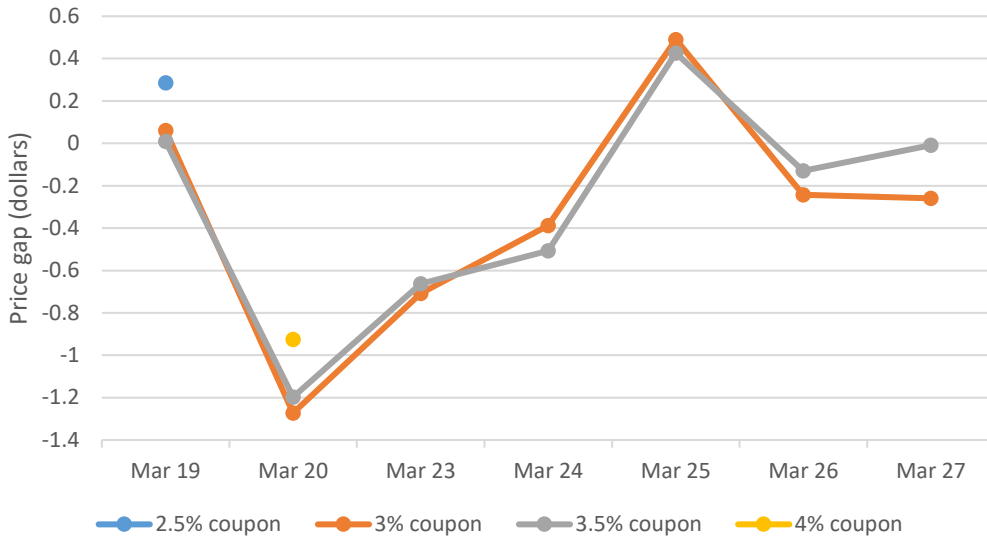
Source: Authors’ calculations, based on data from the Federal Reserve Bank of New York. Notes: The chart plots open market purchases of U.S. Treasury securities by the Federal Reserve by day from January 1 to May 31, 2020. Even before the March 15 FOMC announcement of purchases to promote market functioning, the Fed was engaging in reserve management purchases of Treasury securities and reinvesting principal payments received from its holdings of agency debt and agency mortgage-backed securities. Moreover, the Fed announced on March 13 that it was bringing forward these purchases “to address highly unusual disruptions in the market for Treasury securities.” This explains why there were some purchases in early March and a large quantity of purchases on March 13, before the March 15 announcement of purchases to promote market functioning. Purchases are measured in billions of dollars par.

Chart 16: Open Market Purchases of Agency MBS



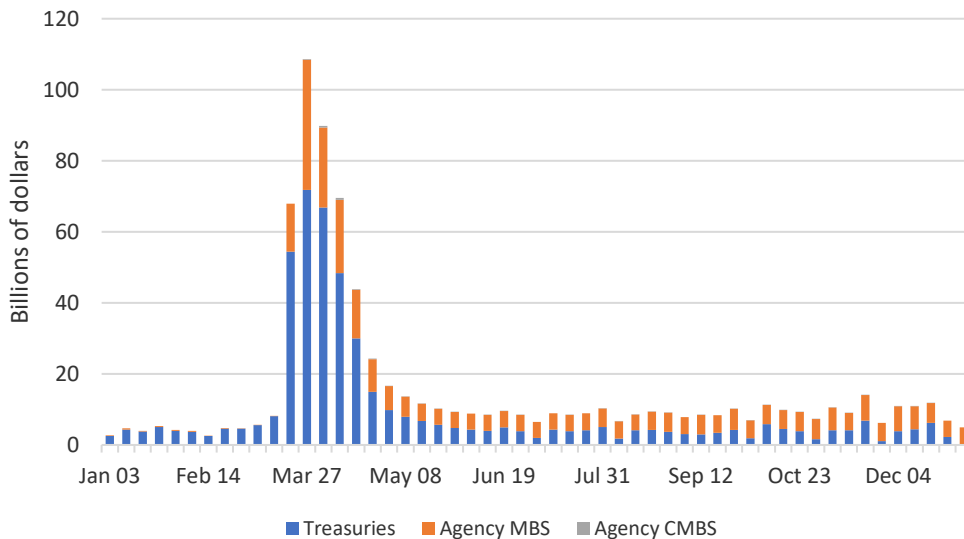
Source: Authors’ calculations, based on data from the Federal Reserve Bank of New York. Notes: The chart plots open market purchases of agency mortgage-backed securities (MBS) by the Federal Reserve by day from January 1 to May 31, 2020, distinguishing between purchases with a regular TBA settlement date and those with a shorter, unconventional TBA settlement date.

Chart 17: Short Settlement Price Discounts for Agency MBS Purchases



Source: Authors’ calculations, based on data from the Federal Reserve Bank of New York.
 Note: The chart plots the average price gap between Federal Reserve purchases for short settlement and Federal Reserve purchases for regular settlement in the same UMBS coupon by day and coupon. Negative (positive) numbers imply that prices for short settlement are lower (higher) than those for regular settlement. Price differences are per \$100 par.

Chart 18: Open Market Purchases by Week (Average Daily)



Source: Authors’ calculations, based on data from the Federal Reserve Bank of New York.
 Notes: The chart plots average daily open market purchases of U.S. Treasury securities, agency mortgage-backed securities (MBS), and agency commercial mortgage-backed securities (CMBS) by the Federal Reserve by week in 2020. Agency CMBS purchases are hard to discern in the chart because they were small relative to Treasury and agency MBS purchases. Purchases are measured in billions of dollars par.

Appendix: Overview of the U.S. Agency MBS Market

A mortgage-backed security is an asset-backed security that is secured by a pool of mortgage loans in which principal and interest payments are passed through to investors on a pro rata basis. MBS that are guaranteed by a government agency (Ginnie Mae) or a government sponsored enterprise (Fannie Mae and Freddie Mac), are known as agency MBS. While most agency MBS are backed by mortgages for single-family homes, agency CMBS are backed by loans for commercial real estate, primarily multifamily residential properties, such as apartment buildings.

The agency MBS market is highly liquid, second only to the U.S. Treasury market domestically (Gao, Schultz, and Song, 2017; Vickery and Wright, 2013). The market had about \$9.8 trillion in securities outstanding at the end of 2020, with an average daily trading volume in 2020 of around \$290 billion.²⁵ In contrast, the larger U.S. corporate market, with about \$10.6 trillion in securities outstanding, had an average daily trading volume in 2020 of around \$39 billion.

The significant transaction volume, depth, and liquidity of the agency MBS market can largely be attributed to the existence of the to-be-announced (TBA) MBS trading convention. In a TBA trade, the buyer and seller agree on the type of security (i.e., agency, program, coupon, face value, price, and settlement date), but the specific underlying pool is not known until close to the settlement day. While the agency MBS market consists of thousands of heterogeneous MBS pools backed by millions of individual mortgages, the TBA trading convention allows trading to concentrate in a small number of liquid forward contracts. TBA trading thus accounts for more than 90 percent of agency MBS trading volume (Vickery and Wright, 2013). The remaining share of volume is accounted for by specified pool (SP) trades, in which the particular security exchanged is agreed to at the time of the trade, with settlement occurring as soon as the same day,

MBS issued by Fannie Mae and Freddie Mac have historically traded in separate TBA contracts. As a result of this segmentation, market liquidity endogenously concentrated in Fannie Mae MBS, with higher trading volume and lower transaction costs than Freddie Mac MBS with similar characteristics (Liu, Song, and Vickery, 2021). To improve liquidity for the overall MBS market, the regulator of Fannie Mae and Freddie Mac, the Federal Housing Finance Agency

²⁵ Source: [SIFMA U.S. Fixed Income Statistics](#).

effectively combined trading of Fannie Mae TBA contracts with Freddie Mac TBA contracts into Uniform MBS (UMBS) contracts in June 2019. Since then, sellers in UMBS TBA contracts can deliver either Fannie Mae UMBS or Freddie Mac UMBS to settle trades.