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# Liquidity and Trading Dynamics in the Off-the-Run U.S. Treasury Market

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**Abstract**

In this article, we study trading activity and liquidity of off-the-run U.S. Treasury securities. Off-the-run Treasuries are seasoned securities, account for about 98 percent of all Treasuries outstanding, and played a central role in the pandemic-fueled dash-for-cash in March 2020. Understanding these securities better can improve thinking around how market resilience might be improved. We document and discuss the evolution of trading activity and liquidity for these securities and how these attributes differ from on-the-run securities. We also consider several potential market structure changes that could improve the liquidity of off-the-run Treasuries, including debt buybacks, expanded central clearing, and increased data transparency.

JEL classification: G12, G18, G20
Key words: Treasury market, market structure, off-the-run, liquidity, trading

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## Introduction

The U.S. Treasury securities market is critically important for the functioning of the global financial system. Treasury securities perform several key functions – they are the method through which the U.S. government funds itself, they are instruments used in the execution of monetary policy, they serve as a global benchmark for other financial instruments, and they are the most prominent safe asset in the world.

The largest segment of this $27 trillion market is the off-the-run market, which accounts for about 98 percent of marketable Treasury debt outstanding. While the most recently issued securities at each tenor are called the "on-the-run" securities, the term "off-the-run" refers to those Treasury securities that are more seasoned, from somewhat recently issued securities, called "near on-the-runs," to extremely seasoned securities, called "deep off-the-runs," and many other securities in between. There are off-the-runs in all Treasury security types (including TIPS, bills, and FRNs), but this paper focuses on the market for off-the-run nominal securities (that is, notes and bonds).

Attention to the liquidity and functioning of the off-the-run market increased sharply following the events of March 2020, when a pandemic-fueled dash-for-cash led to widespread sales of Treasuries (IAWG 2021). This included $287 billion of sales from foreign investors, $266 billion from mutual funds, and $196 billion from the household sector, which includes hedge funds (Vissing-Jorgensen 2021). The vast majority of these sales were in off-the-run securities. During this period, liquidity in off-the-runs decreased notably, with spreads between on- and off-the-run securities widening significantly and other measures of market functioning deteriorating (Fleming, Liu, Podjasek, and Schurmeier 2022). In addition to the events of 2020, off-the-run liquidity has deteriorated during other bouts of volatility, most recently in April 2025 following the announcement of tariffs by the Trump Administration.

Following the 2020 strains, the relevant authorities in the Treasury market began a program of analysis and policymaking to help improve the resilience of this market. This work is spearheaded by the Inter-Agency Working Group for Treasury Market Surveillance (IAWG), which consists of staff from the U.S. Department of the Treasury, the Board of Governors of the Federal Reserve System, the Federal Reserve Bank of New York, the Securities and Exchange Commission, and the Commodity Futures Trading Commission.[1] As part of that work, IAWG staff researched Treasury market structure with an aim to identifying potential improvements in the resilience of Treasury market intermediation. As part of this research, the off-the-run market was identified as an area for future study given that it was the epicenter of the 2020 strains. As such, IAWG staff embarked on a detailed study of the off-the-run market to understand its dynamics better and to consider potential market structure changes and policy proposals that could improve liquidity in the off-the-run market. This paper is informed by this work.

In this paper, we investigate the drivers of trading activity and liquidity of off-the-runs. We analyze off-the-run transaction data from the Financial Industry Regulatory Authority (FINRA) Trade

[1] The Treasury Department, SEC, and Federal Reserve Board formed the IAWG in 1992 to improve monitoring and surveillance and strengthen interagency coordination with respect to the Treasury market following the Salomon Brothers auction bidding scandal. See U.S. Department of the Treasury, Securities and Exchange Commission, and Board of Governors of the Federal Reserve System, 1992, "Joint Report on the Government Securities Market," U.S. Government Printing Office, January 22, available at https://home.treasury.gov/system/files/276/joint-reporton-the-government-securities-Market-1992.pdf.

Reporting and Compliance Engine (TRACE) and summarize findings from structured market outreach to a cross-section of firms active in the off-the-run market. We then consider several potential changes to Treasury market structure that could improve liquidity in the off-the-run market and detail their advantages and disadvantages.

Overall, we document that trading activity in Treasury securities changes notably when they move from being on-the-run to off-the-run, and even more so as securities become more seasoned. Trading volumes decline, trade sizes increase, trade frequency declines, and effective bid-ask spreads widen as Treasury securities age. However, we also find that cheapest-to-deliver securities for a Treasury futures contract tend to trade more actively than other securities of similar age. With these observations in mind, the paper studies a number of proposed market structure changes that have the potential to improve activity in the off-the-run market.

The paper is structured as follows. Section 1 provides background on the off-the-run market including a discussion of the structure of the cash U.S. Treasury market, the main investor types in off-the-runs, and the drivers behind lower liquidity in off-the-runs. Section 2 presents statistics on trading and liquidity in off-the-runs using TRACE data analysis, providing insights into the differing liquidity across various segments of the off-the-run universe. Section 3 surveys some potential market structure changes or policy initiatives that could be considered to improve liquidity in the off-the-run market, and Section 4 concludes.

**Section 1: Background on Off-the-Run Market.**

Trading in the U.S. Treasury market is segmented into the dealer-to-customer market and the interdealer market. In the dealer-to-customer market, trading is primarily dealer-intermediated. Trading in the dealer-to-customer market occurs through various channels, including electronic request-for-quote (RFQ) platforms, direct streaming between dealers and customers, and voice or message-based trades. Much of off-the-run securities trading occurs in the dealer-to-customer market, while a smaller share of on-the-run trading transacts in this segment.

By contrast, in the interdealer market, much of the trading occurs over high-speed central limit order books or CLOBs, a market structure which supports high-frequency price discovery. CLOBS and other electronic platforms are required to register as broker dealers and file a notice of operation as "alternative trading systems" ("ATSs") with the Securities and Exchange Commission. On-the-run trading is dominant in the interdealer market, particularly over the CLOBs, though there is some trading of the first few off-the-runs over these platforms as well. Additionally, in the interdealer market, dealers trade among each other in both on- and off-the-run securities, both electronically and via voice or messaging.

Table 1, which details the average daily trading volume of U.S. Treasury securities across different trading segments and security types, exemplifies this significant disparity between on- and off-the-run securities. As discussed, on-the-run securities exhibit the highest trading volumes, particularly in the interdealer market, where electronic trading dominates. In contrast, off-the-run securities rely more on dealer-to-customer activity, with lower average daily trading volumes, reflecting the reduced liquidity and lower frequency of trades. Notably, Treasury notes and bonds form the bulk of trading activity, with on-the-run notes and bonds transacting $263 billion each day on average in the interdealer market, compared to only $51 billion for their off-the-run counterparts in the

interdealer market. We see the opposite trend in Treasury bills, where the on-the-run market sees an average of $25.6 billion in the interdealer market, while off-the-run bills reach $33.4 billion. TIPS and floating rate notes (FRNs) exhibit significantly lower trading volumes across both segments, indicating their more specialized investor base and less frequent trading activity.

**Table 1: Daily Trading Volume of U.S. Treasury Securities.** This tables reports average daily trading volume of U.S. Treasury securities in billions of dollars between January 1, 2024 and June 30, 2024.

| | On the Run | | Off the Run | | |
|---|---|---|---|---|---|
| | **ATS and Interdealer** | **Dealer to Customer** | **ATS and Interdealer** | **Dealer to Customer** | **Total** |
| *Security Type* | | | | | |
| Notes and Bonds | 262.9 | 174.8 | 51.3 | 103.3 | **592.3** |
| Bills | 25.6 | 39.1 | 33.4 | 76.2 | **174.3** |
| TIPS | 2.8 | 5.9 | 1.3 | 6.2 | **16.2** |
| FRNs | 0.2 | 0.5 | 0.3 | 1.6 | **2.6** |
| **Total** | **291.5** | **220.2** | **86.2** | **187.4** | **785.3** |

ATS is alternative trading system, TIPS are Treasury Inflation Protected Securities, and FRNs are floating rate notes. We exclude trades of when-issued securities and STRIPs. While Depository Institutions started reporting on September 2022, we exclude trades where a depository institution is a reporter but include trades where a depository institution is a counterparty and account those as "client" trades. The latter choice is meant to have a consistent historical comparison, as later analyses use an extended sample, going back to July 2017, when depository institutions were not required to report.

A wide range of investor types participate in the Treasury market including primary dealers, banks, mutual funds, money market funds, exchange-traded funds, hedge funds, pension funds, insurance companies, principal trading firms (PTFs), central banks, and other foreign sovereign institutions and wealth funds. Most types of participants are active in both the on-the-run and off-the-run segments of the Treasury markets, although precise customer volume information is not collected. Broadly speaking, investors active in the off-the-run segment of the market may be more interested in acquiring and holding securities to enhance the safety and liquidity of their portfolios for longer periods of time than firms active in the on-the-run market.[2] In addition to investors who trade less frequently, levered relative value and basis traders can be active in off-the-run securities more routinely. For example, cash-futures basis trading by hedge funds is a strategy that has been used over recent years and involves a leveraged long cash position in the cheapest to deliver security

[2] Moreover, it is important to recognize the possibility that material proportions of long-term portfolio holdings in off-the-run securities may have been acquired at auction or shortly thereafter. For example, U.S. Treasury investor class auction allotment data shows that foreign and international accounts, which includes foreign central banks, an investor type with typically long holding periods, took down 12 percent of coupon securities sold via auction over the period from August-October 2024. As these securities age, they transform from newly issued securities to off-the-runs.

(CTD) into a futures contract and a short position in the corresponding futures contract.[3] The cash position is typically financed with short-term repo borrowing.

In the on-the-run market, due to its high liquidity and electronic trading venues, many investors focus on speculative or hedging strategies. For example, PTFs are active participants in the on-the-run market, as the high-speed market structure there is more suited to their technologically advanced trading style, and these firms often also trade in Treasury futures, adding to cross-market liquidity with active futures to benchmark trading. However, due to their focus on high-speed trading and hesitance to carry inventory, PTFs are not major participants in the off-the-run market.

Off-the-run trading tends to rely more heavily on dealer intermediation as there is less two-way order flow that allows for matching of buyers and sellers without dealers taking on inventory. Chaboud et al. (2025) found that in the off-the-run market, only 18% of customer trading activity had offsetting activity in the same security within the same 15-minute interval, which could make it challenging to find offsetting matches of buying and selling interest in the same security. Moreover, the electronic interdealer market largely focuses on on-the-run Treasuries, and there is not a similar high-speed marketplace where dealers can quickly offload off-the-runs.

An important driver of Treasury market dynamics is the growth in the Treasury market overall. The outstanding amount of US Treasury securities grew from around $5 trillion in 2007 to more than $28 trillion as of the end of 2024, making it the largest sovereign debt market in the world. The market is projected to increase in size by nearly $24 trillion over the next 10 years (Congressional Budget Office 2025).

Dealer capacity has not kept pace with this growth of outstanding Treasuries, limiting intermediation of cash trades and the provision of balance sheet for repo trades, especially during volatile periods (Duffie, 2023; Duffie et al., 2023). Duffie et al. (2023) provide evidence that when dealer balance sheet constraints are binding, liquidity in Treasuries is significantly worse than what would be expected given the level of volatility. Off-the-run liquidity is likely impacted more by low dealer capacity given that off-the-runs rely more heavily on dealer balance sheet capacity than on-the-runs.

It is also possible that liquidity in off-the-runs declines more notably during volatile periods for reasons other than dealer capacity. For instance, trading may become more concentrated in on-the-runs during volatile periods (see Fleming, 2016). Another possibility is that because off-the-runs remain in dealer inventories for a longer period than on-the-runs, and because the compensation required for providing inventory space goes up with volatility, liquidity may decline more for off-the-runs with volatility, as was observed during the spring of 2020 (see Fleming et al, 2022).

**Section 2: Empirical analysis of off-the-run behavior**

As new Treasury securities of the same term are issued, existing Treasuries become off-the-run and less frequently traded. The newly issued securities become the on-the-run benchmark securities

[3] Each Treasury futures contract has a basket of eligible securities for delivery. Generally, one security within that basket is the cheapest for the short position in the contract to deliver to the long position. This is called the cheapest-to-deliver (CTD) security. For more information see https://www.cmegroup.com/education/courses/introduction-to-treasuries/get-to-know-treasuries-ctd.html.

that are traded for hedging and adjusting portfolio duration. The off-the-run Treasuries, as they get more seasoned, increasingly are held by buy-and-hold investors. Treasury securities transaction-level data allows us to observe these dynamics and their effects on liquidity.

In July 2017, the FINRA began collecting certain Treasury transaction level data through TRACE.[4] Using this data, we can study trading activity in the off-the-run market segment, the disparity between on-the-run and off-the-run trading activity, and how trading evolves as a security ages. Treasury TRACE provides trade information about the date, time, buy/sell direction, price, size, and some details on counterparties (the identities of registered broker-dealers who are a side to a trade are known as well as customers to covered ATSs; clients' and non-FINRA member affiliates are masked as ”C” and ”A”, respectively).

In this empirical analysis, we utilize the transactions data to measure trading volume and frequency, as well as liquidity of off-the-run 2-, 5-, 10-, and 30-year securities. It is important to note here that the reliance of our analysis on traded prices and volumes from TRACE, rather than quotes and orders, might bias measurement of trade size and liquidity towards securities for which there was sufficient liquidity to trade.

Table 2 reports summary statistics of average daily volume, trading frequency, and trade size for on-the-run and off-the-run securities in the 2-, 5-, 10-, and 30-year sector.[5] For all terms, the table shows that, on average, off-the-run securities are traded at a larger trade size, less frequently, and with significantly lower volume compared with on-the-run securities. The table also shows that trading volume drops steeply when a security goes from on-the-run to first off-the-run, similar to findings by Barclay, Hendershott, and Kotz (2006), and again drops sharply when going to second off-the-run, reinforcing the notion that as securities age, they are increasingly held by long-term investors rather than being actively traded. For example, in the 2-year sector, on-the-run securities trade on average $56.3 billion per day, first off-the-runs trade $5.5 billion per day, and second off-the-runs trade $1.6 billion per day.

While trading frequency declines with each subsequent off-the-run, just like trading volume, Table 2 reveals a distinct hump shape pattern for trade size. First and second off-the-run securities trade with larger trade sizes compared with the on-the run security, but then there is a gradual decline in trade size. This pattern is consistent with the “migration” of trading from IDB platforms, where the minimum trade size is in $1 million increments and larger trades are often allocated across multiple offer prices and thus appear as multiple smaller trades, to dealer-to-customer voice/messaging trading.

[4] FINRA has collected post-trade transaction data for secondary market Treasury cash securities transactions through TRACE since 2017. Beginning in 2017, this data included all transactions where a FINRA member is a counterparty, including FINRA members that are alternative trading systems. Beginning in September 2022, banks with at least $100 million in average daily trading have also been required to report transactions to TRACE.

[5] The sector of off-the-run securities is determined using the following time-to-maturity buckets: “2-year” includes all securities with (1,2] years-to-maturity; “5-year” includes all securities with 3-5 years-to-maturity; “10-year” includes all securities with (7,10] years-to-maturity; “30-year” includes all securities with (20,30] years-to-maturity.

**Table 2: Average daily volume ($ billions), average daily number of trades, and average trade size ($ millions).** Based on transaction-level data from Treasury TRACE from July 2017 to June 2024, we report the average daily volume in $ billions, the average number of daily trades, and the average trade size in $ millions. For the further-OFR bucket, where multiple securities are reported, we first calculate the average daily volume and average daily number of trades at the security-level; then, we take the average across securities. On-the-run is abbreviated as OTR, and off-the-run is abbreviated as OFR. The 2-year sector includes the on-the-run 2-year note and off-the-run notes and bonds with 1 to 2 years remaining to maturity; 3-year sector includes the on-the-run 3-year note and off-the-runs with 3 to 5 years to maturity; 5-year sector includes the on-the-run 5-year note and off-the-runs with 3 to 5 years to maturity; 10-year sector includes the on-the-run 10-year note and off-the-runs with 7 to 10 years to maturity; and, 30-year sector includes the on-the-run 30-year bond and off-the-runs with greater than 20 years to maturity.

| | # CUSIPs | Avg daily vlm ($ bln) | Avg daily number of trades | Avg trade size ($ mln) |
|---|---|---|---|---|
| 2-Year Sector | | | | |
| OTR 2Y | 1.00 | 56.26 | 14001 | 4 |
| 1st OFR 2Y | 1.00 | 5.51 | 484 | 11 |
| 2nd OFR 2Y | 1.00 | 1.59 | 218 | 7 |
| 3rd OFR 2Y | 1.00 | 0.91 | 157 | 6 |
| 4th OFR 2Y | 1.00 | 0.60 | 140 | 4 |
| 5th OFR 2Y | 1.00 | 0.51 | 170 | 3 |
| Further OFR 2Y | 6.20 | 0.47 | 212 | 2 |
| OFR 3Y | 12.02 | 0.29 | 117 | 2 |
| OFR 5Y | 11.88 | 0.27 | 98 | 3 |
| OFR 7Y | 10.99 | 0.14 | 74 | 2 |
| OFR 10Y | 3.86 | 0.16 | 149 | 1 |
| OFR 30Y | 2.39 | 0.02 | 27 | 1 |
| 5-Year Sector | | | | |
| OTR 5Y | 1.00 | 110.92 | 37900 | 3 |
| 1st OFR 5Y | 1.00 | 7.66 | 465 | 16 |
| 2nd OFR 5Y | 1.00 | 2.23 | 196 | 11 |
| 3rd OFR 5Y | 1.00 | 1.58 | 154 | 10 |
| 4th OFR 5Y | 1.00 | 1.24 | 127 | 10 |
| 5th OFR 5Y | 1.00 | 1.39 | 115 | 12 |
| Further OFR 5Y | 18.15 | 0.47 | 80 | 6 |
| OFR 7Y | 22.55 | 0.11 | 33 | 3 |
| OFR 10Y | 7.99 | 0.14 | 99 | 1 |
| OFR 30Y | 4.43 | 0.01 | 20 | 1 |
| 10-Year Sector | | | | |
| OTR 10Y | 1.00 | 92.05 | 37523 | 2 |
| 1st OFR 10Y | 1.00 | 6.73 | 661 | 10 |
| 2nd OFR 10Y | 1.00 | 2.07 | 322 | 6 |
| 3rd OFR 10Y | 1.00 | 0.98 | 253 | 4 |
| 4th OFR 10Y | 1.00 | 0.73 | 203 | 4 |
| 5th OFR 10Y | 1.00 | 0.57 | 171 | 3 |
| Further OFR 10Y | 6.08 | 0.40 | 121 | 3 |
| OFR 30Y | 5.24 | 0.03 | 34 | 1 |

| | | | | |
|---|---|---|---|---|
| 30-Year Sector | | | | |
| OTR 30Y | 1.00 | 25.45 | 13224 | 2 |
| 1st OFR 30Y | 1.00 | 6.57 | 1744 | 4 |
| 2nd OFR 30Y | 1.00 | 1.62 | 224 | 7 |
| 3rd OFR 30Y | 1.00 | 0.67 | 143 | 5 |
| 4th OFR 30Y | 1.00 | 0.43 | 121 | 4 |
| 5th OFR 30Y | 1.00 | 0.29 | 99 | 3 |
| Further OFR 30Y | 33.66 | 0.27 | 59 | 4 |

An implication of the declining trading activity as securities age is that the pattern of higher trading activity and better liquidity in more recently issued securities is observed within the off-the-run market segment itself. Specifically, we observe that off-the-run trading accounts for about 30 percent of overall trading volume, with first and second off-the-runs accounting for about 15 percent of all coupon activity, whereas deep off-the-runs, which we define as seasoned securities older than the first or second off-the-run, account for the remaining 15 percent.

In terms of liquidity, we measure the (proportional) effective bid-ask spread, which is calculated as the difference between the average price of customer buy trades and the average price of customer sell trades divided by the average price of customer buys and sells. The effective spread aims to measure the realized transaction costs incurred by an investor.

Table 3 reports the mean effective bid-ask spread across maturity buckets for on-the-run, 1-5$^{th}$ OFR, and further OFR for July 2017 – June 2024, and for March 2020. Consistent with the differences in trading volume, on-the-runs have the lowest effective bid-ask spread, i.e., they are the most liquid, and spreads increase for deeper off-the-run securities. In the 5-year sector, for example, we see the effective spread almost doubling from 1.18% to 2.30% in the OTR-to-1$^{st}$ OFR transition. Such sharp increases are also observed for the 2- and the 10-year securities. For the 30-year securities, we observe a similar jump in the effective spreads when they transition from the 1$^{st}$ OFR to the 2$^{nd}$ OFR.

Market stress periods exacerbate these liquidity differences. Consistent with the notion that dealer capacity matters more for off-the-runs, illiquidity tends to increase more dramatically for deeper off-the-runs at times of high volatility. For example, the 2-year OTR spread increased from 0.66% on average in the full sample to 1.38% in March 2020, whereas the first OFR spread increased from 1.22% to 4.23%, and second OFR spread surged from 2.23% to 7.45%, respectively.

It is interesting to note, however, that deep off-the-run securities in some maturity sectors traded with somewhat narrower effective spreads in March 2020 compared with the full sample averages. This can be explained partially by our reliance on transacted prices for the calculation of the effective bid-ask spread. Given many deep off-the-run securities traded infrequently during the 2020 episode (which could indicate the lack of appetite of dealers to provide intermediation services for less liquid securities and/or investors selling the more liquid securities in their portfolios), it is difficult to measure those securities liquidity using effective bid-ask spreads, which rely on data from executed transactions. Overall, the table underscores the challenges faced by investors trading deeper OFR securities, particularly in turbulent market conditions.

**Table 3: CUSIP/day proportional effective spreads (%).** This table displays the mean effective bid-ask spread for two periods: July 2017 – June 2024, and March 2020. The effective bid-ask spread is calculated as the difference between the average price of customer buy trades and the average price of customer sell trades divided by the midpoint price (the midpoint price is halfway between the average customer buy price and the average customer sell price), and it is reported in terms of basis points. On-the-run is abbreviated as OTR, and off-the-run is abbreviated as OFR. The 2-year sector includes the on-the-run 2-year note and off-the-run notes and bonds with 1 to 2 years remaining to maturity; 3-year sector includes the on-the-run 3-year note and off-the-runs with 3 to 5 years to maturity; 5-year sector includes the on-the-run 5-year note and off-the-runs with 3 to 5 years to maturity; 10-year sector includes the on-the-run 10-year note and off-the-runs with 7 to 10 years to maturity; and, 30-year sector includes the on-the-run 30-year bond and off-the-runs with greater than 20 years to maturity. Note that we apply the following filters: (1) we drop trades with a trade modifier of ".B", ".S", or ".W", indicating that they are part of series of transactions that may not be priced at market or are reported with a weighted average price of multiple trades; (2) we keep trades with prices between 25 and 250 that are reported as decimal (not yield); (3) we keep trades between $1 million and $25 million; (4) we drop negative effective spread at the bond-day level.

| | July 2017 - June 2024 | March 2020 |
|---|---|---|
| 2-Year Sector | | |
| OTR 2Y | 0.66 | 1.38 |
| 1st OFR 2Y | 1.22 | 4.23 |
| 2nd OFR 2Y | 2.23 | 7.45 |
| 3rd OFR 2Y | 2.42 | 8.58 |
| 4th OFR 2Y | 2.85 | 10.31 |
| 5th OFR 2Y | 3.34 | 9.44 |
| Further OFR 2Y | 6.89 | 10.52 |
| OFR 3Y | 15.79 | 13.99 |
| OFR 5Y | 27.38 | 16.06 |
| OFR 7Y | 13.15 | 17.92 |
| OFR 10Y | 18.65 | 16.44 |
| OFR 30Y | 18.35 | 31.50 |
| 5-Year Sector | | |
| OTR 5Y | 1.18 | 2.68 |
| 1st OFR 5Y | 2.30 | 10.45 |
| 2nd OFR 5Y | 3.12 | 12.17 |
| 3rd OFR 5Y | 3.89 | 16.46 |
| 4th OFR 5Y | 4.11 | 9.33 |
| 5th OFR 5Y | 4.91 | 15.47 |
| Further OFR 5Y | 36.74 | 65.91 |
| OFR 7Y | 48.94 | 43.80 |
| OFR 10Y | 31.65 | 26.63 |
| OFR 30Y | 17.92 | 47.62 |
| 10-Year Sector | | |
| OTR 10Y | 2.07 | 5.13 |
| 1st OFR 10Y | 3.73 | 16.86 |
| 2nd OFR 10Y | 5.36 | 23.67 |
| 3rd OFR 10Y | 6.05 | 26.33 |

| | | |
|---|---|---|
| 4th OFR 10Y | 6.68 | 27.99 |
| 5th OFR 10Y | 6.95 | 31.49 |
| Further OFR 10Y | 64.77 | 53.38 |
| OFR 30Y | 40.36 | 52.66 |
| 30-Year Sector | | |
| OTR 30Y | 4.96 | 12.59 |
| 1st OFR 30Y | 5.18 | 26.77 |
| 2nd OFR 30Y | 12.35 | 73.39 |
| 3rd OFR 30Y | 16.21 | 66.62 |
| 4th OFR 30Y | 18.34 | 99.66 |
| 5th OFR 30Y | 18.69 | 129.00 |
| Further OFR 30Y | 166.98 | 159.27 |

Next, we analyze the trading activity of securities that are the CTDs for Treasury futures contracts. This subset is useful for understanding whether Treasuries' liquidity is inherent characteristics or can be influenced by market structure. In futures contracts, the seller ("short") chooses which bond to deliver, and the one that minimizes delivery cost – the ``cheapest-to-deliver'' (CTD) security – typically has the tightest link to the futures price. These CTD securities are often more actively traded due to their strategic role in hedging and delivery. General sellers of futures contracts would prefer to deliver the CTD securities and thus seek to buy them in the cash market to make delivery, and traders specifically engaging in cash-futures basis trades would prefer to use CTD securities because using CTD is more profitable (hence why they are the cheapest-to-deliver). Therefore, CTD securities have higher trading volumes and lower transaction costs compared to other Treasuries of similar age.

To quantify the effect of CTD status on liquidity, we run regressions at the CUSIP-level of daily (dealer-to-customer, interdealer, IDB, and total) volumes on bond's off-the-run status (how off-the-run the bond is) and on a CTD dummy that identifies whether a bond is the cheapest-to-deliver for the associated Treasury futures contract. This specification isolates the incremental trading volume associated with a bond being the CTD. In this analysis we focus on three maturity sectors: 2-, 5-, and 10-year sectors to match the top three most traded futures contracts.[6] The CTD dummy is constructed for the 2-year (ZT), 5-year (ZF), and 10-year (ZN) futures by identifying from Bloomberg the CUSIP on each day that is the cheapest-to-deliver of each contract. If the coefficient on the dummy variable is positive and significant, this suggests that CTD securities trade more actively (in terms of dealer-to-customer, interdealer, IDB, and total volumes) than non-CTD securities. Conversely, if the coefficient on the dummy variable is insignificant or negative, it would indicate that CTD status does not provide a liquidity advantage, or that CTD securities experience similar liquidity deterioration to non-CTD securities.

[6] Deliverable securities for the 2-Year T-Note futures contract include securities with 1.75 to 2 years; 4 1/6 to 5 ¼ years for the 5-Year T-Note; and, 6 ½ to 8 years to the 10-Year T-Note. See, CME website for a breakdown of volume by futures contract.

**Table 4: Daily volume regressions ($ billions).** We regress daily CUSIP-level volumes in $ billions on dummies for on-the-run and off-the-run status and a cheapest to deliver (CTD) dummy each trading day from July 2017 to June 2024. In addition to the total volume (column 4), daily volumes are broken down by dealer-to-customer (DTC), dealer-to-dealer (DTC), and interdealer broker (IDB) sectors (columns 1-3). The CTD dummy is constructed for the 2-year (ZT), 5-year (ZF), and 10-year (ZN) futures by identifying from Bloomberg the CUSIP on each day that is the cheapest-to-deliver of each contract. The significance of coefficients is reported as *** significant at 1% level; ** significant at 5% level; * significant at 10% level.

| | (1) DTC | (2) DTD | (3) IDB | (4) All |
|---|---|---|---|---|
| *2-year (ZT)* | | | | |
| OTR | 18.75*** | 3.70*** | 33.75*** | 56.21*** |
| 1st OFR | 3.53*** | 0.54*** | 1.36*** | 5.43*** |
| 2nd OFR | 1.01*** | 0.11*** | 0.38*** | 1.50*** |
| 3rd OFR | 0.60*** | 0.07*** | 0.22*** | 0.89*** |
| 4th OFR | 0.41*** | 0.05*** | 0.15*** | 0.59*** |
| 5th OFR | 0.34*** | 0.04*** | 0.12*** | 0.50*** |
| Further OFR 2Y | 0.32*** | 0.05*** | 0.10*** | 0.47*** |
| OFR 3Y | 0.18*** | 0.03*** | 0.07*** | 0.27*** |
| OFR 5Y | 0.17*** | 0.03*** | 0.06*** | 0.26*** |
| OFR 7Y | 0.09*** | 0.01*** | 0.03*** | 0.13*** |
| OFR 10Y | 0.11*** | 0.02*** | 0.03*** | 0.16*** |
| OFR 30Y | 0.01*** | 0.00*** | 0.00*** | 0.02*** |
| **CTD** | **0.23** | **0.08**** | **0.21** | **0.51*** |
| *5-year (ZF)* | | | | |
| OTR | 39.54*** | 6.58*** | 64.81*** | 110.92*** |
| 1st OFR | 5.24*** | 0.70*** | 1.71*** | 7.65*** |
| 2nd OFR | 1.49*** | 0.14*** | 0.61*** | 2.23*** |
| 3rd OFR | 1.00*** | 0.08*** | 0.50*** | 1.58*** |
| 4th OFR | 0.77*** | 0.06*** | 0.41*** | 1.24*** |
| 5th OFR | 0.87*** | 0.07*** | 0.45*** | 1.38*** |
| Further OFR 5Y | 0.27*** | 0.03*** | 0.10*** | 0.39*** |
| OFR 7Y | 0.08*** | 0.01*** | 0.03*** | 0.11*** |
| OFR 10Y | 0.10*** | 0.01*** | 0.03*** | 0.14*** |
| OFR 30Y | 0.01*** | 0.00*** | 0.00*** | 0.01*** |
| **CTD** | **0.77*****| **0.18***** | **0.37***** | **1.31***** |
| *10-year (ZN)* | | | | |
| OTR | 11.56*** | 1.52*** | 20.70*** | 33.79*** |
| 1st OFR | 2.26*** | 0.29*** | 0.76*** | 3.32*** |
| 2nd OFR | 0.69*** | 0.10*** | 0.23*** | 1.01*** |
| 3rd OFR | 0.51*** | 0.06*** | 0.17*** | 0.73*** |
| 4th OFR | 0.45*** | 0.04*** | 0.14*** | 0.62*** |
| 5th OFR | 0.30*** | 0.02*** | 0.09*** | 0.40*** |
| Further OFR 7Y | 0.15*** | 0.01*** | 0.05*** | 0.20*** |
| OFR 10Y | 0.18*** | 0.02*** | 0.05*** | 0.25*** |
| OFR 30Y | 0.01*** | 0.00*** | 0.00*** | 0.01*** |
| **CTD** | **0.44***** | **0.15***** | **0.17***** | **0.75***** |

Table 4 shows that cheapest-to-deliver securities trade more than comparable non-CTD bonds. For instance, in the 5-year sector, being the CTD is associated with an additional $1.31 billion in daily trading volume. This effect is driven by all three trading segments: dealer-to-customer ($0.77 billion), interdealer ($0.18 billion), and IDB ($0.37 billion). Similarly, in the 10-year sector, the CTD dummy is associated with $0.75 billion higher total daily volume, while the 2-year CTD effect is smaller at $0.51 billion and marginally statistically significant. These results reinforce the interpretation that CTD status conveys a liquidity advantage – CTDs attract higher trading volumes across venues. Importantly, this finding suggests that CTD bonds retain greater liquidity even if they are well off-the-run and that arbitrage and basis trading strategies help sustain trading volume.

In addition to the CTD effect, Table 4 also shows a strong and monotonic decline in trading activity as bonds age, echoing the raw trading patterns reported in Table 2. For example, in the 2-year sector, the coefficient on the 1st OFR dummy is 5.43, closely matching the $5.51 billion average daily volume reporting for the 1st OFR securities in Table 2. This pattern persists across maturities: in the 5-year sector, trading volume declines from $7.65 billion for the 1st OFR to $1.38 billion for the 5th OFR, aligning with the decline from $7.66 billion to $1.39 billion in Table 2. Although, the regression coefficients are not expected to exactly match the raw averages (since they control for other covariates), their relative magnitudes mirror the summary statistics, confirming that trading activity steadily declines with each step away from the on-the-run benchmark.

**Section 3: Potential Market Structure Changes that Could Increase Liquidity in Off-the-Runs**

As the trading venue for nearly all Treasury securities outstanding, and with trading volume of nearly $275 billion per day on average, it is important to consider if there are potential initiatives that could improve liquidity in the off-the-run market. After studying the dynamics in the off-the-run market, we considered some potential changes to U.S. Treasury market structure, including policy actions, that could lead to improved liquidity in off-the-runs. Below we briefly discuss some of these ideas and their potential advantages and disadvantages.

<u>Official sector purchases (e.g., buyback program)</u>

Official sector purchases can offer a backstop to liquidity because market participants know they can offer the securities they own to the official sector in a future set of purchases, as is described in Duffie and Keane (2023). This is similar to the dynamic we observed above with CTD securities – when there is a consistent source of demand for Treasury securities, their liquidity improves. There have been several examples of these types of programs over recent years, including most recently, the introduction in May 2024 of a regular Treasury buyback purchase program.[7]

In this most recent buyback program, Treasury has introduced two types of buyback operations – liquidity support buybacks and cash management buybacks. Under the liquidity support buybacks, Treasury intends to bolster market liquidity by providing regular opportunities for market participants to sell off-the-run Treasuries to the Treasury. The cash management buyback operations are intended to help Treasury manage the volatility in its cash balance and bill issuance. In both types of buybacks, Treasury aims to be a price-sensitive buyer, with the quantity bought

[7] For more information on Treasury buyback operations, see https://treasurydirect.gov/help-center/faqs/buyback-faqs/.

back in any given operation conditional on the quality of offers it receives. In the first half of 2025, Treasury announced liquidity buyback purchases of up to $30 billion per quarter and cash management purchases of approximately a maximum of $20 billion per quarter. The actual amounts of purchases have been somewhat less than these maximums.

Analysis of buyback purchases by the Treasury Borrowing Advisory Committee found that the program is broadly meeting its objectives to bolster market liquidity and reduce volatility in the Treasury cash balance.[8] In particular, the securities that were selected for purchase were generally viewed as cheap at the time of purchase in a relative-value framework, which may indicate their poorer liquidity compared to other securities. However, the analysis noted that the buyback program, at its current size, is fairly modest relative to overall market volumes and dealer holdings of Treasuries.

In July 2025, Treasury announced planned enhancements to the buyback program to better achieve its liquidity support and cash management goals.[9] The planned changes include increasing the frequency of long-end nominal coupon liquidity support buybacks, increasing the size of cash management buybacks, and allowing a limited number of additional counterparties to directly access buyback operations. Currently, counterparties to the buyback operations are limited to the Federal Reserve Bank of New York's primary dealers, while Treasury plans to offer direct buyback access to additional counterparties based on their participation in Treasury primary auctions. One important caveat to remember when contemplating an increase in size to any buyback purchases is that Treasury's ability to buy back securities is limited by the cash it has on hand and its ability to raise additional cash for liquidity support buybacks, a limitation that can be constraining during debt limit impasses.

Increased central clearing and supplementary leverage ratio modifications

As we discussed in Section 1, dealer balance sheet intermediation capacity significantly impacts off-the-run liquidity. Many have argued that expanding central clearing, particularly in Treasury repos, could enhance this capacity (Duffie, 2020; Liang and Parkinson, 2020). Central clearing allows for greater netting of matched-book repo positions, reducing the total leverage exposure in supplementary leverage ratio (SLR) calculations. This makes the SLR less binding, freeing up balance sheet capacity, which could benefit off-the-run liquidity directly by increasing dealers' ability to intermediate the securities or indirectly through dealers' increased capacity to intermediate repo (most off-the-run trading involves repo financing). Central clearing of Treasury repos is expected to grow substantially due to SEC rule amendments adopted in December 2023.[10] Market estimates suggest that up to $4 trillion in daily transaction volume could move to central clearing, but the

[8] Treasury Buyback Program Effectiveness Assessment, Presentation by the Treasury Borrowing Advisory Committee, February 4, 2025.
[9] Quarterly Refunding Statement of Deputy Assistant Secretary for Federal Finance Brian Smith, July 30, 2025.
[10] The implementation details and resulting market structure changes are still being determined, with some challenges remaining. See Central Clearing in the U.S. Treasury Market; The Why and the How, Remarks by Michelle Neal, Head of the New York Fed's Markets Group, October 15, 2024.

actual balance sheet savings will be less as many repos are already structured to net (Bowman, Huh, and Infante, 2024).[11] .

Expanding central clearing on cash Treasury trades could also help improve off-the-run liquidity. First, increased central clearing reduces bilateral credit risk, which would increase the willingness of firms to trade with a greater number of counterparties. This is particularly beneficial for off-the-runs, which often trade bilaterally. Second, increased use of central clearing may pave the way for all-to-all trading opportunities to emerge in the off-the-run market by eliminating the need to set up bilateral clearing arrangements.[12] Lastly, increased multilateral netting also reduces settlement fails and the associated counterparty credit risk, which can adversely affect market liquidity.[13]

Agencies have proposed changes to the regulatory capital standards to make SLR less binding.[14] SLR was originally intended to be a backstop to the risk-based capital requirements but had become a more binding constraint in recent years. If SLR becomes less binding, Treasury cash and repo positions would become less expensive for the dealers from a regulatory perspective, which could allow them to intermediate more, potentially improving liquidity of the market overall including the off-the-run segment.

Increased data transparency

Increasing data transparency could enhance the liquidity and price efficiency of off-the-run Treasuries. Transparency in on-the-run Treasury trading is higher than in off-the-run trading, largely due to the amount of price and transaction data available on CLOBs, which may help explain some of the decline in liquidity that occurs when securities move from on-the-run to off the run.

One way improving transparency could bring about better liquidity in off-the-runs is by improving the bargaining power of liquidity consumers, increasing their knowledge of where the price is and reducing information asymmetry. A second way is by lowering barriers to participation for new liquidity providers that require more transparency. Such effects could be greater for off-the-run Treasuries, which have lower price transparency than on-the-run notes and bonds.

Academic literature has broadly found that the introduction of post-trade transparency has decreased trading costs in corporate bond markets (Bessembinder, Maxwell, Venkataraman, 2006; Edwards, Harris, and Piwowar, 2007; Goldstein, Hotchkiss, and Sirri, 2007). Gradual and carefully crafted increased transparency is likely prudent to avoid any risks associated with excessive transparency. For example, real-time disclosure of large transactions might be counterproductive in that intermediaries could be less willing to provide liquidity if trades they intermediate are disclosed before they can hedge the associated inventory risks.

Thus far, Treasury transparency has been expanded at a gradual pace, an approach former Treasury Undersecretary Liang has described as “walk not run”.[15] Most recently, starting in March 2024,

[11] Depository Trust and Clearing Corporation, DTCC Survey Identifies Significant Improvements in Industry Understanding and Preparedness Around Expanded U.S. Treasury Clearing, July 15, 2024.
[12] We will discuss all-to-all trading towards end of the section.
[13] Multilateral netting involves the offsetting of payment flows resulting from trades among more than two parties, using a clearing house or central exchange.
[14] Agencies request comment on proposal to modify certain regulatory capital standards, June 27, 2025.
[15] Remarks by Under Secretary for Domestic Finance Nellie Liang at the 2022 Treasury Market Conference, November 16, 2022.

FINRA began disseminating trade data at the end of the day for on-the-run coupon Treasury securities, with trade size caps.[16]

Increased Concentration of Treasury Issuance in Fewer Securities

Another possibility for improving off-the-run liquidity is for Treasury to concentrate its issuance into fewer and larger-sized issues. Currently, Treasury issues some of its nominal securities on a monthly basis (2-, 3-, 5-, and 7-year securities) and others on a quarterly basis with two reopenings (10-, 20- and 30-year securities). The quarterly issues concentrate three months of issuance into one security, whereas for the monthly issues, each month's issuance results in a separate security. In 2023, the Treasury Borrowing Advisory Committee considered the benefits and risks of Treasury transitioning the currently monthly issues to quarterly issues similar to the 10-, 20-, and 30-year securities.[17]

Concentrating issuance into larger securities would focus trading activity, potentially leading to improved liquidity. In Canada, for example, securities are reopened until they achieve a particular size, at which point they are designated benchmark securities. Berger-Soucy et al. (2018) show that trading activity improves in Canadian sovereign bonds as they are reopened and move towards benchmark status. However, the issuance sizes required for a security to be designated benchmark status in Canada range from 18-30 billion CAD, significantly lower than the new-issue sizes for the current Treasury nominal monthly issues.[18] Fleming (2002), in fact, finds little relationship between issue size and liquidity when U.S. Treasury bills are on-the-run, but significant liquidity improvements when bills are off-the-run. That is, even if larger issue sizes did not improve liquidity of already highly liquid on-the-run Treasuries, additional size could benefit liquidity when securities go off-the-run.

Trading efficiencies could also result from more concentrated issuance. Transaction costs related to index rebalancing, for example, might be reduced if portfolio rebalancing trades were spread across fewer securities. Additionally, if there were fewer Treasury issues, fewer securities would qualify as deliverable for a Treasury futures contract, likely resulting in less frequent CTD switches (and probably of more liquid issues) reducing the transactions costs associated with repositioning into a new CTD.

However, there are potential drawbacks to more concentrated Treasury issuance. Some market participants may prefer monthly issues over quarterly issues to achieve their portfolio targets. Finer-spaced maturity dates may be particularly important to firms managing to very specific target maturities. Fewer maturities of larger issues may also make cash management and the rollover of funds from maturing issues more challenging. Larger auction sizes may hence increase the risk of an auction performing worse than expected as well as the ramifications of such an outcome.

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[16] For instance, a $300 million transaction in a 5-year on-the-run note is disseminated with a trade size of "250MM+".

[17] Considerations for changing the issuance schedule for 2-, 3-, 5- and/or 7-year Treasuries, Presentation by the Treasury Borrowing Advisory Committee, May 2, 2023.

[18] For Canadian benchmark size ranges, see table A2.4 here: https://budget.canada.ca/2024/report-rapport/anx2-en.html. For current issue sizes of U.S. Treasury nominal securities, see the most recent Quarterly Refunding Policy Statement here: https://home.treasury.gov/policy-issues/financing-the-government/quarterly-refunding/most-recent-quarterly-refunding-documents.

The question ultimately arises as to the net effect of these various considerations for the U.S. Treasury's borrowing costs. To the extent that market participants prefer finer-spaced maturity dates, reducing their number should increase Treasury borrowing costs. But if the improved liquidity of larger securities dominates the preference for additional maturity dates, then concentrating issuance further could lower Treasury borrowing costs. In the case of Treasury bills, Fleming (2002) finds that larger issues are more liquid, but also trade at lower prices, suggesting that the liquidity benefits of increased supply are more than offset by their costs.

All-to-All Trading

As discussed in Chaboud et al (2025), all-to-all trading in Treasuries, in its purest form, would allow any market participant to trade directly with any other market participant, without relying on dealer intermediation, which is a notable constraint for trading off-the-runs. The resulting increase in the number of potential matches and the reduced reliance on dealer intermediation may then, at least in principle, contribute to a deeper and more resilient Treasury market, especially when dealer balance sheets are constrained.

There is currently no all-to-all trading venue in the Treasury market. However, a range of trading protocols offered by various platforms exhibit some attributes of all-to-all trading, often allowing market participants who are traditionally liquidity consumers to also act as liquidity providers. As discussed in Chaboud et al (2025), this includes central limit order books, anonymous streaming, anonymous request for quotes and matching auctions.

Matching auctions, sometimes called "periodic call auctions," may be particularly well suited for the off-the-run market, in which many securities trade infrequently.[19] In such a protocol, a trading platform arranges for matching auctions between potential buyers and sellers to occur at certain times of the day (even potentially once a day), thereby concentrating liquidity to a few limited time periods. The distinction between liquidity provider and liquidity consumer effectively disappears. There is also no function for the intermediation capacity of dealers, including their need to build inventories of infrequently traded securities.

To allow transactions among all participants in all-to-all venues, the platform typically becomes the counterparty to both sides of the trades, like a traditional exchange. The buyers and sellers are therefore anonymous to each other, and counterparty credit risk between them is not an issue. Increased use of central clearing in the U.S. Treasury market may facilitate an increase of these types of protocols.

One way to evaluate the potential success of a matching auction in the off-the-run market is to look at the quantity of offsetting buys and sells that occur over a given period of time. Chaboud et al. (2025) analyze FINRA TRACE transaction data and find that in off-the-runs, only 19 percent of customer trading activity has an offsetting trade in the same security within 15 minutes. However, when looking over the entire trading day, the prevalence of matching increases notably, reaching over 50 percent, suggesting that both buyers and sellers could appear in meaningful numbers if the auction frequency were not too high.

[19]Some attempts at introducing matching auctions to the off-the-run market have been unsuccessful due to the lack of buy-in by key stakeholders.

## Conclusion

The market for off-the-run Treasuries is a key part of the Treasury market, making up about 98 percent of Treasuries outstanding. Due to the size of the off-the-run market, it can be an epicenter for market functioning issues during times of volatility, as was witnessed in the spring of 2020, and more recently in April 2025. Understanding trading dynamics in this market is critical to preparing for future Treasury market strains and evaluating possible policy options.

Analysis of transaction-level data on off-the-runs shows a change in trading behavior as securities move from on-the-run to off-the-run, with trades occurring at larger sizes, lower frequency, and overall lower volumes, with effective bid-ask spreads also widening. Interestingly, as securities become the cheapest to deliver into the Treasury futures contract, we see their trading activity increase, particularly for deep off-the-run securities. This finding demonstrates that liquidity of off-the-runs can be improved, and their liquidity is not an inherent characteristic.

Given this potential for improvement, we discussed the ability of a number of market structure changes to improve liquidity of off-the-runs. While it seems unlikely that any single market structure change discussed would materially improve the liquidity of the off-the-run market, the combination of various approaches may move the needle. Most promising are those that create increased trading opportunities for off-the-runs, such as official sector purchases and all-to-all trading, and those that improve dealer intermediation capacity such as expanded central clearing.

In future work it would be beneficial to study in more detail the effects of the market structure changes that are currently underway, such as the expansion of central clearing in the U.S. Treasury market and the use of buyback purchases for liquidity support, once there is sufficient data to rigorously study the effect of these changes.

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