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Reaching for Duration and Leverage in the Treasury Market*

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Abstract

We show substantial variation in mutual funds' use of Treasury futures, both over time and across funds. This variation from mutual funds drives much of the time series variation in aggregate Treasury futures open interest, including over 60% of the recent rise in Treasury futures positions. We provide evidence these Treasury futures positions are largely attributable to mutual funds "reaching for duration" in order to track the duration of a benchmark index with high cash Treasury exposure. Specifically, we show mutual funds use futures to fill the gap between their portfolio and the index that results when they tilt their cash positions toward higher return but lower duration assets, such as mortgage-backed securities and equities, and away from cash Treasuries. Treasury futures positions are more common in mutual funds which indicate a focus on dual objectives of duration management and total return whose style has a higher allocation to Treasuries. Reaching for duration allows funds to track their index better at lower cost, but increases leverage in the Treasury market both through mutual funds long Treasury futures positions and through the leverage of hedge funds who take the corresponding short positions in Treasury futures.

Keywords: Treasury markets, mutual funds, duration, indexing, futures, mortgage-backed securities

JEL Codes: G11, G12, G13, G23

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1 Introduction

Recent events have illustrated the risks of non-bank leverage in Treasury markets. In March 2020, large sales by a variety of Treasury investors placed pressure on levered actors in the Treasury market that may have exacerbated a general dash for cash and thereby contributed to a burst of illiquidity.[1] Similarly, leverage among Liability Driven Investment companies contributed to the 2022 gilt market crisis.[2] Historically, levered bets in Treasury markets also contributed to Treasury market instability in the 1950s and 1960s.[3] The risks posed by outsized leverage in the Treasury market make understanding the incentives to lever Treasury positions an important area of focus for regulators and policymakers. Yet, because of the difficulty in observing the activities of most non-bank actors, there have been relatively few studies of the determinants of cross-sectional and time-series variation in leverage in Treasury markets.

In this paper, we examine mutual fund leverage in the Treasury market resulting from long Treasury futures positions. We form a unique dataset by merging information on mutual funds and their cash and derivatives investments from multiple sources, including regulatory data and fund prospectuses. Using this data, we show that mutual funds' demand for long Treasury futures is substantial: mutual funds make up roughly 53% of all asset manager long Treasury futures positions, which stood at $579 billion in notional outstanding in June 2023, and 31% of long open interest in Treasury futures. Moreover, there is substantial time series and cross-sectional variation in the use of Treasury futures by mutual funds. Futures use by mutual funds exhibits a strong procyclical pattern, falling by almost 25% between December 2019 and June 2021 before rising by 65% between June 2021 and June 2023. Between 2021 and 2023, mutual funds made up 62% of the increase in total open interest in long Treasury futures. Further, while Treasury futures positions are concentrated in a few mutual fund strategies, even within these strategies there are large cross-sectional differences in Treasury futures holdings.

We provide evidence that this variation is driven by funds' incentives to "reach for duration," using Treasury futures to lengthen the duration of their portfolio to match the interest rate risk of their benchmark indexes while reducing their cash Treasury positions and investing in other se-

[1]See Duffie (2020) He et al. (2020), Schrimpf et al. (2020), Vissing-Jorgensen (2021), Barth and Kahn (2021) and Kruttli et al. (2021) among others for a discussion.

[2]See Pinter (2023) and Alfaro et al. (2024).

[3]See Garbade (2021), Kahn and Nguyen (2022) and Menand and Younger (2023).

curities with higher expected returns. Specifically, when fixed-income mutual funds increase their long Treasury futures positions, they simultaneously decrease their holdings of (longer-duration) Treasury securities and increase their holdings of (shorter-duration) mortgage-backed securities (MBS). We find that funds with broader objectives also increase their holdings of equities. This suggests that by using Treasury futures, mutual funds can track their benchmark indexes while holding less cash Treasuries and more higher-yielding assets.

Reaching for duration results from a tension between the duration of the index that funds are benchmarked against (often, for futures users, the Bloomberg U.S. Aggregate Index) and the need to generate returns. Treasury holdings tend to be both the highest duration and one of the lower-yielding assets in fixed-income fund portfolios. The share of Treasuries in the Aggregate Index is both large and has grown over time, rising from 35% in 2011 to almost 45% in 2023 as Treasury issuance has expanded. In addition to being low-yielding, these Treasuries are also primarily off-the-run, making them costly to hold relative to other more liquid and higher-yielding assets. Active funds therefore have an incentive to allocate away from these Treasuries and towards other assets. Indeed, we find that in general active funds tracking the Aggregate Index have lower duration than the index but higher returns. By using futures, funds can obtain a similar duration to the Aggregate Index using fewer cash Treasuries. We find that the mutual funds that use Treasury futures track their benchmark index better overall, even though the duration of their cash holdings tends to differ more from the duration of the cash holdings in the index when their futures holdings are high. We show that these funds' futures holdings close the gap between the duration of their cash positions and the duration of the benchmark index.

The incentive to reach for duration is driven in large part by the opportunity cost of investing in higher-duration assets: foregone positions in low-duration assets. Over recent quarters, we show much of the variation in reaching for duration is driven by changes in returns to investing in low-duration mortgage-backed securities relative to Treasuries. We find that Treasury futures holdings are larger when the expected returns on mortgage-backed securities are higher, measured both in terms of option-adjusted spreads and dollar roll specialness. The increased allocation towards mortgage-backed securities and away from Treasuries that results drives most of the changes in the duration of cash assets for futures users relative to the index that futures users then make up with their derivatives holdings.

In the cross-section of funds, we find that the use of futures is highly persistent, and the largest futures users tend to be the same funds over time. There is little difference in performance between futures users and non-users, but the flow-performance relationship is weaker for futures users, which may be due to demand for the duration exposure these funds provide. Among Treasury futures users, the use of derivatives is often specifically mentioned in their prospectuses' sections on principal risks and strategies and is significantly less commonly mentioned by non-users, providing an important bar to short-term entry. We find futures use is more common among funds that have a greater incentive to reach for duration along two dimensions. First, they are more likely to track their benchmark indexes more closely, and their prospectuses may state explicit goals to match their benchmark index duration. Second, they appear to be more likely to take on active positions that count on the appreciation of securities. In particular, evidence from fund prospectuses indicates that funds with higher futures positions tend to have higher turnover, objectives focused on total return rather than income, and higher fees. Taken together, this constitutes strong evidence that mutual fund leverage in Treasury futures is driven by incentives to reach for duration that vary over the cycle.

Our results show that mutual funds use Treasury futures to match their benchmark index return while tilting towards higher-yielding assets with their cash portfolio. This stands in contrast to recent research on mutual fund use of derivatives including Kaniel and Wang (2022) and Choi et al. (2023). In both cases, the authors find that mutual funds use derivatives primarily as a means of amplifying returns and taking on additional risk. While we find that funds that use Treasury futures are increasing the duration of their overall portfolio, we show that these funds generally remain below the duration of the index they track. Funds with high use of futures are therefore closer to the performance of the index than those without. Meanwhile, both high futures users and funds that do not use futures tilt away from the index in different ways. The closest comparable paper to our own is Choi et al. (2023), which examines the use of interest-rate derivatives by mutual funds. While their sample includes users of Treasury futures, it is dominated by users of interest-rate swaps. They find that funds are often using interest-rate derivatives for speculation and that derivative portfolios and cash portfolios are often unrelated. In contrast, we find that funds use Treasury futures specifically to match their index duration while tilting towards higher-yielding assets with their cash portfolio. Rather than suggesting that mutual funds are using Treasury futures for independent speculation or to amplify returns, we show that mutual funds are using Treasury futures to reach for yield in a way that is consistent with their overall investment objectives and the structure of their benchmark indexes. Therefore, in the case of Treasury futures, we find that cash positions and futures positions are intimately related.

In demonstrating the tilt towards riskier mortgage-backed and asset-backed securities by mutual funds that use Treasury futures, our paper also contributes to a large literature on risk-taking and reaching for yield in mutual funds and other asset managers, including Kacperczyk and Schnabl (2013), Becker and Ivashina (2015), Di Maggio and Kacperczyk (2017), Choi and Kronlund (2018) and Chen and Choi (2023). Reaching-for-yield behavior is similar to the reach-for-duration behavior we demonstrate in this paper in that in both cases the funds' portfolio is tilted away from the index and towards higher yield assets. The two behaviors therefore both result from a tension between the need to generate returns and the need to match an index or benchmark. However, the reach-for-duration behavior we examine involves weighting the portfolio of the fund towards one higher-yielding asset class away from another given an overall objective to match duration. On the other hand, reaching for yield involves tilting towards higher-yielding assets within a class or rating, given an objective to maintain a certain share in each rating or asset class. In the case of reaching for duration, we show that the tension between returns and benchmarking can ultimately have consequences for financial stability through driving large mutual fund positions in Treasury futures.

By examining long positions in Treasury futures, we also contribute to the literature on the cash-futures basis trade.[4] This literature has generally discussed short positions in Treasury futures, which as discussed by Schrimpf et al. (2020), Barth and Kahn (2021), Kruttli et al. (2021), Banegas et al. (2021), Barth et al. (2023) and Glicoes et al. (2024) are often taken by hedge funds to exploit a positive basis between cash and futures markets. The existence of a positive basis has often been explained as a result of the costs of holding cash Treasuries for dealers, as in Fleckenstein and Longstaff (2020) and Du et al. (2023). This leaves open the question of why other actors would be willing to take the long futures position. Our results suggest that mutual funds take the

[4]Cash-futures bases exist in many markets outside of U.S. Treasuries. For instance, Hazelkorn et al. (2023) studies the cash-futures basis in equity markets. They find that flows to mutual funds tracking an index are an important driver of demand for that index's equity futures, but in their case the relationship appears to be from mutual funds' demand for the cash index rather than futures.

long side of futures positions to shift their cash holdings away from Treasuries and toward higher-yielding cash assets. A positive basis means that this leverage could theoretically be accomplished more cheaply using Treasury cash securities borrowed in the repo market. However, we provide evidence that most mutual funds are severely limited in their ability to use repo leverage by the terms of their prospectuses and by the costs of transacting in the repo and cash Treasury market. Moreover, consistent with the model in Barth and Kahn (2021), our results suggest that mutual fund demand for Treasury futures, driven by an incentive to reach for duration, may be a contributor to the overall demand for Treasury futures, and therefore to the positive basis distinct from the balance sheet costs of dealers.

Finally, our results have implications for the literature on Treasury inconvenience. Results in Duffie (2020), He et al. (2020), and Du et al. (2023) suggest that as Treasury issuance continues, the cost of holding Treasuries has risen substantially. However, the focus of these papers has generally been on regulatory costs to large Treasury exposures on dealer balance sheets. Our results point to substantial implicit costs of holding cash Treasuries, and especially off-the-run cash Treasuries, for mutual funds — costs that are avoided by these funds holding futures instead. The general rise in outstanding Treasuries has led to a rise in the share of Treasuries in the index funds many mutual funds track and thereby may have increased the need for mutual funds to allay these costs. We also show that the demand from mutual funds for Treasury futures to replace Treasury securities depends on the returns to MBS, which provides an important link from Treasury inconvenience to other asset markets and, implicitly, the real side of the economy.

2 Data

For aggregate futures data, we use the Commodity Futures Trading Commission's Traders in Financial Futures data, which provides weekly information on long and short positions for broad categories of investors — dealers, asset managers, leveraged investors (primarily hedge funds), and others, and for a wide range of contracts, including Treasury futures.

We rely on three principal micro-level data sources: the CRSP Survivor-Bias-Free US Mutual Fund Data, the SEC's Form N-PORT, and a hand-collected dataset formed by scraping mutual fund prospectuses.

The SEC's Form N-PORT provides detailed portfolio holdings for mutual funds on a quarterly basis, as well as fund-level information including assets and liabilities, certain risk exposures, and returns. Funds that together with other funds under the same parent investment company have net assets of $1 billion or more were required to begin reporting Form N-PORT for the period ending March 31, 2019, but filings only became public starting September 30, 2019. Smaller fund groups began reporting for the period ending March 31, 2020.

We scrape the universe of N-PORT filings from 2019 to 2023 from the SEC's website. This results in 208,579 filings in total. For our purposes, the key advantage of the N-PORT data is that it has details on funds' holdings of derivatives. Importantly, N-PORT identifies futures, swaps, forwards, and option positions separately, which allows us to focus on the Treasury futures holdings of mutual funds. We therefore primarily use the N-PORT data to identify futures positions. We verify the validity of both data sources by comparing fields where the N-PORT data and CRSP data overlap and find they provide similar results.

We use keywords to extract the Treasury futures positions from N-PORT. For instance, futures derivative positions containing the strings"2y," "5y" and "10y" are likely to be 2-year, 5-year and 10-year Treasury futures positions. However, we are careful to exclude words suggesting that these may be non-U.S. futures positions, such as "EUREX," "JPN" or "gilt." Similarly, positions labeled "TU", "FV" or "TY" are likely to be 2-year, 5-year and 10-year Treasury futures because these strings correspond to the tickers listed on Bloomberg. Finally, we spot-check this classification against a sample of funds to ensure that the procedure is accurate. In all, we identify 96,227 unique Treasury futures positions across funds and over time.

In addition to the data on futures positions, we also use the N-PORT data for detailed information on holdings of cash assets. N-PORT provides some general classifications of investments based on their asset type and issuer. Most of these classifications are straightforward. We classify investments as Treasuries whenever their issuer is identified as the Treasury Department, which can include certain bills otherwise classified on N-PORT as cash assets. Investments in MBS are classified as agency MBS when they are recorded as MBS and their issuer is a U.S. government agency or government-sponsored enterprise, and as private-label MBS if their issuer is corporate.

To provide more detail on fixed-income instruments, we use ICE pricing and valuation data. This data covers a wide range of fixed-income securities, including corporate debt, ABS, MBS, Treasuries, and non-U.S. sovereign debt. It contains two key features for our analysis. The first is the duration of cash investments, which we use to study the overall duration of mutual funds' cash portfolios. The second is ratings for corporate debt by Fitch, Moody's, and S&P, which we use to classify corporate debt securities into investment-grade and speculative-grade debt. We classify investments as speculative grade whenever at least one of these three rating agencies rates it as speculative grade. We match this data to N-PORT investments based on the CUSIP of the security and the date of the filing.

While ICE covers a broad range of instruments, we do not have access to details on duration for the to-be-announced (TBA) MBS market. As we describe below, the TBA market is a popular investment for certain mutual funds heavily invested in Treasury futures. We use data from JP Morgan Markets to provide an estimate of the duration of these instruments. We also use JP Morgan data on spreads, duration, convexity, and dollar roll specialness for aggregate analysis, and for the duration of Treasury futures contracts. This sample covers the period from 2012 to 2023.

We use the SEC's Mutual Fund Prospectus Risk Return dataset and scrape additional data from the SEC's website covering the universe of mutual fund prospectuses. We use this data to identify the stated objectives, strategies, and risks of funds, their benchmark indexes, and to identify funds that have stated objectives to use derivatives. We merge based on funds' SEC-assigned series identifier. For a subset of fixed income funds we are interested in their benchmark index. A subset of funds lists this benchmark directly in their N-PORT filings, in which case we use this as the fund benchmark. For the remaining funds, the benchmark is determined by matching key phrases in the fund prospectus to a list of common fixed-income benchmarks, such as the Bloomberg U.S. Aggregate Index, the Bloomberg U.S. Universal Index, or the Bloomberg Credit Index. First, we search the principal strategy section of the prospectus to find a match. If we cannot find a match in this section, we then search the remainder of the prospectus.

We then merge the N-PORT data with the CRSP Survivor-Bias-Free US Mutual Fund data to obtain a comprehensive dataset of mutual fund holdings, returns, fund characteristics, and futures positions. The CRSP data provides monthly holdings and daily returns for mutual funds. We use data beginning in 2015 for the purposes of this study. CRSP identifiers do not overlap with the N-PORT data. We perform a match between datasets first using fund tickers where possible to match between the two sets, then using fund names where tickers are not available. When matching on fund names, we first look for whether the CRSP name contains both the series name from N-PORT and the regulatory name from N-PORT, since often the CRSP name is a concatenation of these two names with additional characters describing the share class. In the case that this procedure produces multiple matches, we then hand-select between the matches. For a select group of funds that we are unable to match using this procedure, we then hand-match the funds. We are able to match 13,481 funds between the two datasets for the period 2019 through 2023.

3 Aggregate Treasury futures positions of mutual funds

One of the more dramatic changes in Treasury market activity over the past decade is the significant rise in Treasury futures volumes. Aggregate positions in Treasury futures have risen from roughly $500 billion in notional exposure in 2010 to over $2 trillion in 2024. This growth has received attention primarily due to worries about the growth in hedge funds' short Treasury futures positions, which seem to primarily support their activity in the cash-futures basis trade.[5] Yet, much less is known about the incentives for investors to take long positions in Treasury futures. Below, we describe the essential features of the U.S. Treasury futures market. We then show that the primary investors in long Treasury futures are asset managers, with the majority of positions accounted for by mutual funds. We demonstrate these positions show substantial variation over time and across funds, though it is usually the same funds holding the largest futures positions across time. The rest of the paper then focuses on what drives both the time-series and cross-sectional variation in mutual fund holdings of Treasury futures, to understand the drivers of this major concentration of leverage in the Treasury market.

3.1 Structure of the futures market

The Treasury futures market has been covered elsewhere in great detail, for instance in Burghardt and Belton (2005) and Barth and Kahn (2021). Here, we provide a brief overview of some salient features of the market structure and the role of asset managers in this market.

[5]See Schrimpf et al. (2020), Barth and Kahn (2021), Kruttli et al. (2021), Banegas et al. (2021),Barth et al. (2023) and Glicoes et al. (2024).

Treasury futures are offered at a variety of different maturity points. The most common contracts are the 2-year, 5-year, 10-year, and 30-year Treasury futures. Each contract is settled via physical delivery. The CBOT allows for several different Treasuries in a specified range of maturities to be delivered into each contract. Allowing the delivery of multiple securities is commonly thought to afford additional liquidity to the Treasury futures market, and the Treasury futures market is generally thought to be more liquid than Treasury cash securities, provided those securities are not on-the-run (see Baker et al. (2020)).

The price, duration, and yield of a Treasury futures contract are related to the underlying Treasuries because of the option to physically deliver Treasuries into the contract at expiration. This near-arbitrage relationship is enforced by the Treasury cash-futures basis trade, which is discussed at length in Burghardt and Belton (2005), Fleckenstein and Longstaff (2020) and Barth and Kahn (2021). As a result of this trade, the price and risk attributes of a Treasury futures contract will closely replicate a Treasury cash security, the difference being that the futures contract does not require the full notional amount to be posted upfront. The only cash requirement at the initiation of a futures contract is the initial margin. Variation margin may also be called if the position depreciates (or appreciates for the short position) enough. This allows for the use of leverage in the Treasury futures market, which we discuss below as a key feature of the attractiveness of Treasury futures to asset managers.

3.2 Asset manager Treasury futures positions

As discussed in Barth and Kahn (2021), asset managers make up the major source of demand for long Treasury futures positions. Figure 1 shows the growth in aggregate short and long futures positions separately for three entity types: hedge funds, asset managers (including mutual funds), and other types. As shown in Figure 1, the majority of long Treasury futures positions are held by asset managers. As of January 2024, asset managers accounted for 58% of the $2.04 trillion in total open interest. Figure 1 also shows that asset managers are always net long Treasury futures and that their long futures positions are always significantly larger than their short futures positions. Finally, the figure also illustrates that hedge funds in general take up the opposite side of asset managers' futures positions.

Perhaps more importantly, asset managers account for a substantial proportion of the *changes* in aggregate long futures positions over time. Figure 2 plots the cumulative change in aggregate long futures positions against the cumulative change in asset managers' long futures positions between January 2018 and March 2024. On average over this period, asset managers account for 83% of the cumulative variation in aggregate long futures positions.

While it has been documented previously that asset managers drive a substantial share of the variation in Treasury futures open interest, much less is known about which types of asset managers are responsible for this activity. The asset manager category in CFTC futures data is broad, comprising mutual funds, pension funds, endowments, sovereign wealth funds, and other entity types.

Using data from Form N-PORT, we show that mutual funds account for a large proportion of the variation in total long asset manager futures positions. Figure 3 plots the cumulative change in long Treasury futures positions from N-PORT data against the cumulative change in asset manager futures positions from CFTC futures data between January 2020 and September 2023. A significant portion of the decline in aggregate futures following the stress in Treasury markets in early 2020, as well as a significant portion of the rise in long asset manager Treasury futures beginning in late 2021, are due to changes in mutual fund Treasury futures positions. In total, mutual funds accounted for 53% of asset manager long Treasury futures positions in June 2023. The significant overlap between asset manager and mutual fund Treasury futures is notable given that these data originate from different sources.

Table 1 shows the long futures positions of asset managers and mutual funds for three dates: December 2019, June 2021, and June 2023, roughly corresponding to the dates of the pre-COVID peak, most recent trough, and most recent peak (as of the writing of this paper and available N-PORT data). The table shows that throughout the period, mutual funds' share of total asset manager futures has stayed relatively constant at just about 50%. Mutual funds also accounted for a majority of the decline from December 2019 to June 2021, and the subsequent rise from June 2021 to June 2023.

Mutual funds appear to have disproportionately large positions in the shorter-maturity Treasury futures contracts, which are also the contracts most heavily associated with hedge-fund basis trading. Table 1 shows these positions segmented by contract. Mutual fund holdings are particularly high in the 2-year and 5-year contracts, which Barth and Kahn (2021) argue have been the focus of basis traders. Whereas mutual fund long futures from N-PORT data account for just over 50% of total asset manager long futures from CFTC data, they account for over 70% of the 2-year and 5-year notional amounts. And, mutual funds account for 80% of the growth in asset manager long Treasury futures between June 2021 and June 2023 in the 2-year and 5-year contracts.

Mutual funds' substantial portions of the level and cumulative change in aggregate long Treasury futures positions make their motives for holding Treasury futures important for recent developments in Treasury markets, especially in the leverage and Treasury holdings of hedge funds. However, mutual funds are also important to study in this context because their motivations for using leverage in the Treasury market may help shed light on the motivations of other, more opaque asset management structures such as separately managed accounts, liability-driven investment funds, endowments, or sovereign wealth funds. Further, mutual funds' incentives to vary their use of Treasury futures over time may be a hint as to the motivations of other asset management types that hold futures. While no statistics are currently available for the other 47% of asset manager positions, anecdotal evidence suggests that much of the remaining notional outstanding is held by separately managed accounts, which often have similar investment objectives and restrictions as mutual funds.

For these reasons, this paper explores mutual funds' significant use of long Treasury futures positions, with an eye toward understanding both time-series and cross-sectional variation.

3.3 Mutual fund styles and Treasury futures

The use of long Treasury futures by mutual funds is concentrated in a few specific investment styles. Table 2 shows the total assets and long Treasury futures notional amounts, along with the share of all mutual fund long Treasury futures positions accounted for, by Lipper objective code (representing the fund's investment style) for three different dates. The Intermediate Investment Grade Debt style ("IID") accounts for roughly one-third of the total long Treasury futures held by mutual funds. Short Investment Grade Debt funds ("SID"), Balanced funds ("B"), and Short Intermediate Investment Grade Debt funds ("SII") account for another 19%. IID funds not only account for a large share of the total long Treasury futures positions but also a large share of the total decrease from 2019 to 2021 (59%) and increase from 2021 to 2023 (32%).

Intermediate investment grade debt funds are, according to Lipper, defined as "[F]unds invest primarily in investment grade debt issues (rated in top four grades) with dollar-weighted average maturities of five to ten years." This objective code contains funds that are sometimes called "Core" or "Core Plus" Bond Funds in the industry. These funds are usually benchmarked to the Bloomberg U.S. Aggregate Bond Index (formerly the Barclay's U.S. Aggregate Bond Index), or less commonly the U.S. Universal Bond Index. The Aggregate Bond Index is a broad index of U.S. fixed-income securities, including investment-grade Treasuries, agency MBS, corporate debt, and ABS, but notably excluding floating rate securities and sub-investment grade debt. Treasuries make up nearly 45% of the index.

Figure 4 examines the holdings of IID funds over time, both in notional amounts and as a weighted average share of total assets. As can be seen, notional amounts of IID funds follow total mutual fund long Treasury holdings closely. Moreover, the share of these positions in total assets displays the same pattern. This implies that the use of Treasury futures by these funds is not driven by changes in the size of the IID sector, but actually represents higher relative allocation towards Treasury futures.

Because IID funds represent such a large share of the futures markets, and because it is useful to make a comparison between funds that are similar in their investment objectives, we focus on IID funds in many of the later analyses. However, we note that there are many similarities between IID funds and SID and SII funds. All three categories invest in investment-grade debt issues and maintain relatively short dollar-weighted average maturities. The main difference is that SID funds invest in debt with average maturities of less than three years, while SII funds invest in debt with average maturities of three to five years. Finally, while balanced funds invest in a mix of equities and fixed-income securities (usually on a 60/40 basis) their debt portion is often indexed to the Aggregate Bond Index or a similarly broad index.

Even within a fund investment style, there is substantial variation in the use of long Treasury futures. Table 3 shows the distribution of notional amounts of Treasury futures on June 23rd, 2023, for the subset of investment styles shown in Table 2, as well as the percentage of funds within that style that hold a positive amount of long Treasury futures. For IID-style funds, 54% report holding some long Treasury futures. The median amount held is $3 million, the 75th percentile is $140 million, and the 99th percentile is $15.18 billion. SID-style funds had 50% long Treasury futures ownership, with similar percentiles of notional amounts other than the 99th percentile, which held only $3.13 billion. SII-style funds also demonstrate significant long Treasury futures ownership, with a 75th percentile of $70 million, and a 99th percentile of $7.28 billion.

The high concentration of long Treasury futures among certain investment styles suggests these fund types have particular incentives to hold Treasury futures. It also makes comparisons within fund styles particularly convenient. However, the heterogeneity within funds of the same style also suggests that other factors are driving the cross-sectional variation in the use of Treasury futures beyond the broad style of investing. We will return to these issues below.

3.4 Net Treasury futures holdings and duration

Mutual funds hold short as well as long Treasury futures. However, the majority of mutual funds' Treasury futures positions are long, especially during times of high overall futures use such as 2019 and 2023. The top panel of Figure 5 shows gross long, gross short, and net long Treasury futures positions of mutual funds in notional billions. Short positions are relatively low in 2019, peak in early 2022, and decline through 2024. They therefore follow the opposite pattern as the long positions, and as a result, the U-shaped pattern of long positions over this period is even stronger for net positions.

One concern with this pattern of futures holdings might be that funds are actually using futures to place direct bets on the shape of the yield curve, for instance through steepeners or flatteners. If this represents the usual use case for Treasury futures, we would expect the duration of mutual funds' futures portfolios to be roughly flat over time. However, the bottom panel of Figure 5 shows that the duration of mutual funds' futures holdings actually the total net notional pattern. This suggests that futures are not being used primarily for yield curve bets. A more detailed comparison is provided in A.1, which shows that this inverse-U-shaped pattern generally holds across the different maturities of Treasury futures, again suggesting that funds are not using futures to make bets on the shape of the yield curve.

3.5 Persistence in mutual funds' Treasury futures positions

The set of funds holding long Treasury futures appears persistent over time. Figure 6 plots aggregate long Treasury futures positions for four groups of mutual funds, based on futures holdings as of June 2023: funds with no long Treasury futures positions, funds in the bottom one-third of long Treasury futures positions (by notional amount), funds in the middle-third of long Treasury futures positions, and funds in the top one-third of long Treasury futures positions. As shown in the figure, the substantial majority of total long Treasury futures positions are held by mutual funds in the top one-third of positions. This pattern dates back to January 2020; that is, the mutual funds that hold the most long Treasury futures in June 2023 comprise the significant majority of long Treasury futures positions across the entire sample period for which N-PORT data are available. This suggests that it is predominately the same funds that increase and decrease the intensity of long Treasury futures over time, rather than the set of large futures users shifting over time.

Looking at the largest futures holders broadly supports this view. Table 4 shows the identities of the top 10 funds by long Treasury futures positions, their net assets, and comparisons of notional amounts held on December 2019, June 2021, and June 2023, both in dollars and as a percentage of assets. Overall, the largest holders of long Treasury futures in June 2023 also held significant positions in December 2019. Moreover, many of the largest holders of long Treasury futures are IID funds. Notably, the largest Treasury futures user as of 2023 was the American Balanced Fund, which held $34 billion of long Treasury futures in June 2023, or 77% of all futures holdings of balanced funds. Six of these ten funds also share the same manager: American Balanced Fund, Bond Fund of America, American Funds Strategic Bond Fund, Intermediate Bond Fund of America, the U.S. Government Securities Fund, and American Funds Inflation Linked Bond Fund are all managed by Capital Research & Management. This suggests an important role for the fund manager in determining the stance of funds towards Treasury futures.

Results from a simple linear probability model also support the view that futures positions are persistent within funds. A regression of an indicator for whether the fund holds long Treasury futures in June 2023 on an indicator for whether the fund held long Treasury futures in January 2020 delivers a coefficient of 0.73 with a t-statistic of 104. The R^2 from this regression is nearly 50%. Prior long futures positions appear to be a strong predictor of future long Treasury futures positions, indicating this is a persistent feature of certain mutual funds portfolio choices across changing interest rate and investment opportunity environments.

The persistence in these futures positions suggests that funds that hold long Treasury futures can be treated as a somewhat distinct category from those that do not, and one that persists over time. It also underscores that the decision to hold futures is a persistent feature of certain funds' investment strategies, rather than a response to short-term changes in the investment environment, even if the level of futures holdings varies more substantially over time. We therefore begin by examining the time-series variation in fund futures positions, especially how futures positions co-move with other investments in their portfolio, before returning to the cross-sectional variation in futures positions and the incentives that drive that variation.

4 Futures positions and portfolio choices of mutual funds

In this section, we examine the portfolio choices of futures users and non-users. We concentrate on IID funds since they have both high futures holdings and high variance of holdings across funds, but relatively similar investment objectives. We show that funds that hold long Treasury futures make different portfolio choices than those that do not, and then discuss how these choices create demand for Treasury futures.

4.1 Treasury futures and portfolio choices

We begin by focusing on IID funds. We make additional restrictions on the sample of funds to make portfolio choices more comparable. First, we include only funds that list the Bloomberg Aggregate Index as their target index. Second, we exclude funds that have more than 90% of their assets in equities or registered investment companies — this drops a few feeder funds that report investments almost exclusively in their respective master funds. Finally, we drop any exchange-traded funds.

Table 5 reports the percentage of total assets of IID funds held in various asset classes as of three dates: December 2019, June 2021, and June 2023. The investment allocations of three types of funds are examined: index funds, active fund non-futures holders, and active fund futures holders. Sorting into active fund futures holders and non-futures holders is done by holdings as of June 2023, so that we are comparing the same funds over time. The dates chosen again correspond to the pre-Covid peak in futures use, the most recent trough, and the post-Covid peak. Therefore, assets that decrease in the first period and increase in the second period are more likely to be related to the increase in futures positions. By comparing these changes to index funds, we isolate the active component of futures holders' asset management decisions. By comparing them to non-index funds, we can isolate the components of these decisions that are related to the use of futures.

The first asset class covered in the table is cash Treasury securities. It is immediately clear that both types of active funds hold fewer Treasury securities than index funds, at a little more than half of the allocation to Treasuries of these funds. Similarly, the allocation of the Bloomberg Aggregate Index to Treasuries was roughly 40-45% throughout this period, a little less than double the allocations of active funds. The difference is particularly notable for shorter maturity Treasuries. This already suggests that allocation away from Treasuries is a popular strategy among active funds.

Table 5 provides evidence that Treasury futures serve as a substitute for holdings of cash Treasuries for futures users. As a benchmark, index funds reduced their cash Treasury holdings by 2% between December 2019 and June 2021, then increased their holdings by 3% between June 2021 and June 2023. Between December 2019 and June 2021, non-futures holders followed a similar path, reducing their cash Treasury positions by 3%. Similarly, non-futures holders exhibited a slight decrease in their holdings of cash Treasuries (as a percentage of assets) between June 2021 and June 2023. This stands in stark contrast to futures holders. Futures holders *increased* their allocation to cash Treasury securities by 6% of assets between December 2019 and June 2021, then reduced these holdings by 5% of assets between June 2021 and June 2023. Recall that mutual funds reduced their long Treasury futures positions between December 2019 and June 2021, then increased these positions between June 2021 and June 2023. This suggests that, for Treasury futures holders, cash Treasuries and Treasury futures are substitutes.

One potential objection to this evidence would be that the short time series afforded by the N-PORT data is not enough to make inferences about the substitutability between Treasury cash and futures. To extend the sample, we examine holdings of 2023 futures holders and index funds over time using the CRSP mutual funds monthly holdings data.[6] Figure 7 shows visually the contrast in cash Treasury positions between Treasury futures holders and non-futures holders. The light-blue line plots aggregate futures positions by asset managers from CFTC data, the same data reported in Figure 1. In green, we plot the total cash Treasury investments of IID index funds, and in dark blue we plot the total cash Treasury investments of IID futures holders. The green line shows a steady, upward path, driven primarily by the increase in assets under management of IID funds over this period. The green line shows little resemblance to aggregate asset manager Treasury futures positions. The dark blue line, on the other hand, remains roughly flat between 2015 and late 2020 — while non-futures users were growing their cash Treasury positions, futures users were keeping them constant. Only in late 2020, once aggregate asset managers' futures fell, did futures users begin to grow their cash Treasury holdings. This pattern swiftly reversed in early 2022, as cash Treasuries fell substantially amid a new wave of rising long Treasury futures positions.

Table 5 also shows ways in which both futures-holders and non-futures-holder active funds tilt away from the index. For instance, index funds have negligible allocations to CDOs, ABS contracts other than agency MBS, and speculative-grade corporate debt. This largely follows the construction of the Bloomberg Aggregate Index, which excludes speculative-grade debt and most CDOs and other ABS. Additionally, both non-futures holders and futures holders have higher allocations to corporate debt than index funds, with non-futures holders having an even higher allocation than futures holders. Especially, for corporate debt positions and private-label MBS, these positions may involve additional exposure to credit risk not present in the benchmark index. However, exposures to these instruments do not appear to be related to the aggregate pattern of Treasury futures holdings among mutual funds, with all categories being fairly constant as a share of futures holder assets over the three periods.

Alternatively, Treasury futures holders have much higher allocations to MBS, and particularly agency MBS, than either index funds or non-futures holders. The allocation to MBS for index funds is a little under a quarter of assets, and this allocation is relatively constant over time. Non-futures holders have a higher and more variable allocation, between 23 and 30 percentage points of

[6] We are unable to observe futures holdings of these funds prior to 2019, so our analysis here relies on the assumption that futures holdings were also quite persistent prior to 2019. Without any source of data on futures, it is impossible to externally validate this assumption, but given our results on holdings, it appears reasonable.

assets, with a decline of 6 percentage points between 2019 and 2021 and an increase of 3 percentage points between 2021 and 2023. However, the allocation of futures holders is as high as 43% of assets in December 2019, with a decline of nearly 16 percentage points between December 2019 and June 2021, and a subsequent increase of roughly 11 percentage points between June 2021 and June 2023.

That the increase in MBS for futures holders is not only coincident with the pattern of usage of futures positions but also that this change is not present in the index allocation provides strong evidence that this change is associated with futures use. Building on this intuition, Figure 7 plots the difference in the cumulative change in asset class investments since 2015 for futures holders and non-futures holders (here including both index and active funds). The measure shown in the figure is:

$$m_{i,t} = \left(\sum_{j \in F} w^F_{j,t} \times \text{holding}_{i,j,t} - w^F_{j,T} \times \text{holding}_{i,j,T} \right) - \left(\sum_{j \notin F} w^N_{j,t} \times \text{holding}_{i,j,t} - w^N_{j,T} \times \text{holding}_{i,j,T} \right)$$

where F is the set of futures holders, $w^F_{j,t}$ is the share of assets for fund j in all futures holders at time t, $w^N_{j,t}$ is the share of assets for fund j in all non-futures holders at time t, and $\text{holding}_{i,j,t}$ is the holding of asset class i by fund j at time t. This measure is essentially a difference-in-differences, with similar advantages because it partials out the time-invariant differences between funds and the time-varying differences between funds that are not related to futures holdings. However, we do not intend it as a causal measure, but rather as a way of exploring associations between futures use and portfolio choices.

Figure 7 reinforces that changes in Treasury holdings and mortgage-backed securities for futures holders are both coincident with periods of higher futures holdings and larger than changes for non-futures holders. In Figure 9, we show the raw cumulative changes further subdivided into index funds and futures holders. These illustrate that index fund allocations to MBS and cash Treasuries are essentially constant over time, while futures holders tilt towards MBS. The evidence in these two figures shows that shifts in the portfolios from Treasuries to MBS are primarily the result of reallocation from futures funds not present (or more muted) in index funds and non-futures holders.

These figures do not allow us to examine the intensive margin of futures use or to make statistical comparisons. In Table 6, we evaluate the portfolio choices of funds formally. Table 6 regresses the percentage of the fund's AUM held in different asset classes on the ratio of a fund's long Treasury futures notional value to AUM. The left-hand side variable is not exactly a portfolio weight because we are using notional values, while portfolio weights would depend on the market value of the derivatives contract. As a result, without fixed effects, the sum of coefficients across asset classes should be nearly zero, since asset shares must sum to one and the cash outlay to open a futures position is relatively small.[7] To account for attributes of the fund's overall strategy that may be correlated with funds that use futures, we include fund fixed effects, while to account for time variation in the attractiveness of investments that do not vary with futures use, we include time fixed effects. Notably, the fund fixed effect will essentially exclude all funds that never use futures, so that these effects will be identified on the intensive margin.

Column (1) in Panel A shows that, as a percentage of assets under management, Treasury futures and cash Treasury securities are strongly negatively correlated. A one percentage point higher allocation to (notional) long Treasury futures is associated with a 0.125% higher allocation to cash Treasury securities, with a t-statistic on the coefficient above 10. The benefit of investing in Treasury futures over Treasury cash positions is that an equivalent exposure to Treasury yields requires much less cash upfront. Column (2) of Panel A provides evidence of how this extra cash is being deployed by long Treasury futures holders. A one percentage point increase in long Treasury futures is associated with an increase of 0.047% in MBS. This relationship is also highly statistically significant, with a t-statistic of around four. Investments in ABS also increase, with a similar magnitude and a higher t-statistic of above 6, though this change is more concentrated in smaller funds and so does not show up to the same degree in the aggregate. In Table A.2 in the Appendix, we examine these shifts in more detail, finding that the increase in MBS is roughly split between agency and private-label MBS. One possibility is that these MBS positions are associated with dollar rolls (see Song and Zhu (2019)). We construct an estimate of dollar roll activity from the minimum of short and long TBA positions and show this is not the driver of the overall response.

[7] The cash requirements to open a Treasury futures position is the initial margin, which varies by contract, but was $1,150 for the 2-year contract, $1,400 for the 5-year contract, and $2,125 for the 10-year contract as of April 1st, 2024 (recall that each 2-year contract represents $200,000 notional, and the 5-year and 10-year contracts represent $100,000 notional).

Meanwhile, for other ABS investments, the increase is driven by a rise in CDOs, with a smaller but still significant contribution from other non-MBS classes of ABS.

In column (3), Panel A of Table 6, we find no statistically significant association between long Treasury futures and broad corporate debt. Table A.3 in the Appendix provides a breakdown of corporate debt investments to examine whether the lack of an overall effect masks a transition towards riskier debt. Instead, we find that there is a shift from speculative-grade to investment-grade debt, as well as from U.S. to non-U.S. debt. This suggests that there is not a significant shift of futures holders into more credit-sensitive instruments that are not present in the Aggregate Index. In column (5) of Table 6, we do find evidence that as Treasury futures increase, so too does the amount of cash held, possibly in anticipation of future margin requirements on the increased futures positions, although this result is weaker than for cash Treasuries, MBS and ABS (with a t-statistic just below 1.6).

Panel B of Table 6 repeats the regressions in Panel A, but includes all fund strategies. As in Panel A, long Treasury futures positions are strongly negatively related to cash Treasury positions. Also, similar Panel A, column (2) shows that MBS is positively related to Treasury futures use. However, unlike Panel A, allocations to corporate debt are negatively related to long Treasury futures, and there is a strong positive relationship with equity investments. The relationship here is driven primarily by balanced funds, for whom corporate debt and Treasuries are closer substitutes, and equity is an allowable investment with higher returns. Overall, Panel B provides further support for a reach-for-duration motive: funds with higher Treasury futures positions reduce their lower-yielding Treasury and corporate bond holdings while increasing their allocations to MBS and equities.

On the other hand, we do find that there is a shift of futures-holders towards floating rate debt, a category also excluded from the index. Table 7 shows the portfolio shifts associated with long Treasury futures also correspond to a shift from fixed to floating-rate debt. Column (1) of Table 7 shows that a higher allocation to Treasury futures is associated with a lower value of fixed-rate debt; a one percentage point increase in long Treasury futures relative to assets is associated with a 0.089% decrease in fixed-rate debt holdings. Conversely, as shown in column (2), the same change in long Treasury futures corresponds to a 0.047% increase in floating rate debt. Similarly, column (3) shows that holdings of variable rate debt, a type of debt security where the interest rate resets periodically, also increases as long Treasury futures increase. This is consistent with the overall shift towards MBS and CDO since among floating-rate securities in the data, 28% are MBS, 19% are collateralized debt obligations (CDO), and 32% are loans, with another 10% in other asset-backed securities.

Meanwhile, the top panel of Table 8 shows that futures use is associated with a decrease in fund investments in shorter-maturity debt. This effect is most pronounced for cash Treasuries, as shown in the bottom panel, with more than half of the total association coming from Treasuries due in less than five years. This is consistent with the aggregated evidence in 5 that funds that hold long Treasury futures have a lower allocation to shorter maturity Treasuries. As we shall see it also has important implications due to the relatively long maturity of Treasury securities compared to other investments for IID funds.

The results in this section strongly imply that Treasury futures use is associated with changes in the cash portfolios of the mutual funds that take on futures positions. The changes in investments that we observe are consistent with funds moving from lower-yielding Treasuries to higher-yielding assets, though, notably, these funds do not take on credit risk, and it is unclear why these funds choose to conduct this reallocation when they do. Additionally, in contrast to previous results established by examining other derivatives contracts used by mutual funds such as Choi et al. (2023), this implies that the cash portfolio and Treasury futures portfolio are strongly related. However, the relationship between these investments is unclear. Why should funds increase their holdings of Treasury futures when they decrease their holdings of Treasuries and increase their holdings of MBS? We explore this question in the next section, providing evidence that the use of Treasury futures is related to an attempt to match the duration of the overall index while tilting towards MBS. In the following section, we then examine the cyclical incentives for funds to invest in agency MBS, and how these incentives are related to the use of Treasury futures.

4.2 Aggregate Treasury futures and mortgage-backed securities

The prior section documented a significant shift from cash Treasury securities to MBS associated with an increased allocation to long Treasury futures. This suggests the relative attractiveness of MBS is an important factor in the time-series variation of mutual funds' use of Treasury futures.

To test this hypothesis more formally, we focus on the to-be-announced (TBA) segment of the residential MBS market (RMBS), which are often the instruments of choice for asset managers due to their superior liquidity (see Vickery and Wright (2013)). A TBA trade is essentially a forward contract on a generic pool that satisfies certain specified characteristics, including the GSE program, original loan maturity, and coupon. Specifically, we focus on the front, nearest-maturity TBA trades for current coupon FNMA 30-year instruments.[8] We provide results based on alternative underlying securities in Appendix A.1.3.

We use a variety of measures to proxy for the attractiveness of RMBS positions. We use option-adjusted spreads (OAS) as a measure of the current attractiveness of RMBS securities, and the specialness of the current dollar roll to proxy for expected RMBS returns.[9] Song and Zhu (2019) show that dollar roll specialness is negatively associated with expected TBA returns. Figure A.13 depicts the time series of the considered RMBS variables.

RMBS have other features that are relevant for Treasury futures holdings. Specifically, effects related to option-adjusted duration and convexity. While underlying mortgages typically have original maturities of 30-years, the option-adjusted durations of RMBS tend to be much lower due to prepayments. The top left panel of Figure A.13 plots the duration of the bellwether TBA FNMA 30-year current coupon: since 2016 its duration has been lower than 6 and even below 4 after 2022.[10] Duration of the bellwether TBA trended downward between 2013 and March 2020, and then again during the recent period of high interest rates. This suggests that funds substituting out of cash Treasuries and into MBS may be lowering overall portfolio duration. Further, MBS have negative convexity, while Treasury securities have positive convexity. While convexity is a second-order sensitivity, it becomes crucial when interest rate volatility increases and duration matching results in insufficient hedging precision. Consequently, asset managers who tilt toward RMBS may also need to use various Treasury futures to match the convexity of the benchmark as well.

Our RMBS variables are observed at the daily frequency. For comparability to weekly aggre-

[8]Current coupon is the highest coupon that makes the TBA trade at or below the par value.

[9]A dollar roll is essentially a calendar spread in TBAs. Dollar roll specialness is the difference between the corresponding financing repo rate and the dollar roll implied (break-even) financing rate (see the online appendix to Kandrac (2018) and Song and Zhu (2019) for details).

[10]As duration is a measure of sensitivity to rates (and not of maturity), we avoid suggesting that it is measured in years; albeit, in general, it is a useful heuristic.

gate Treasury futures data, we aggregate them to weekly frequency by averaging over the trading days between two consecutive observations of the weekly futures data (including the right boundary of the time interval).[11]

We test the extent to which RMBS characteristics explain asset managers' long Treasury futures positions by estimating the following specification:

$$\omega_t = \alpha_0 + \mathbf{X}_t \beta + \textbf{roll.eff}_t + \sum_{i=2}^{12} \gamma_i \textbf{Month}_t^i + \epsilon_t. \quad (1)$$

ω_t is the fraction of all long Treasury futures positions (aggregate or in a specific group of futures contracts) held by asset managers; $\mathbf{X}_t$ is a subset of considered RMBS explanatory variables; $\textbf{roll.eff}_t$ is an indicator for a futures roll date (when dominant open interest shifts from one contract to another), and $\textbf{Month}_t^i$ are calendar month fixed effects to capture any seasonality. In the Appendix, we discuss how we address issues related to cointegration and other time-series concerns.

Table 15 contains estimates of specification (1) for asset managers' aggregate positions, normalized by aggregate open interest, and various sets of explanatory variables. All variables are scaled to generate coefficient estimates of the same orders of magnitude; spreads are expressed in basis points while duration and convexity are scaled by 100.

Model I examines the yield-chasing response of asset managers. The coefficient on the option-adjusted spread (OAS) is positive and significant at the 1% level, consistent with current MBS returns motivating asset managers to shift their portfolios into RMBS when RMBS returns are attractive. The coefficient on dollar roll specialness is negative but statistically insignificant. Recall that Song and Zhu (2019) show find a *negative* relationship between dollar roll specialness and expected RMBS returns. Therefore, the negative coefficient on dollar roll specialness is consistent with higher expected returns being associated with additional positions in RMBS. A comparison of the goodness of fit measures for Models I and II indicates that both models have significant explanatory power. Model II combines both channels, and we find qualitatively similar.

[11] Alternative approaches include (i) retaining only the most recently available end-of-day variables for each weekly observation and (ii) fitting a MIDAS specification of Ghysels et al. (2004). Due to persistence in the time series of RMBS variables, these approaches yield qualitatively similar results. Moreover, the persistence of covariates likely induces large standard errors of the parametric lag weight in the MIDAS specification.

Finally, we hypothesize that the decision to rotate into RMBS would likely depend on a history of returns and expectations, requiring a period of attractive returns and heightened expectations to motivate meaningful portfolio shifts. Model III relies on 8-week moving averages of OAS and dollar roll specialness, and obtains greater significance for MBS-return related covariates, along with a slightly improved fit. Figure 11 depicts the actual and fitted time-series of asset managers' aggregate positions (as fractions of open interest), based on model III.

5 Duration

Why do Treasury futures appear to serve as complements to MBS and ABS investments but as substitutes to cash Treasuries? In this section, we provide evidence that IID funds use Treasury futures to manage their duration. This dovetails with results in later sections that show that one predictor of futures use in the broader cross-section of funds is the extent to which their prospectuses mention duration in their principal strategies. This is particularly common for IID debt funds. For instance, the summary prospectus of the Western Asset Core Plus Bond Fund states that the objective of the funds is to:

> "Maximize total return, consistent with prudent investment management and liquidity needs, by investing to obtain the average duration specified below."

In turn, this duration target is specified as being "within 30% of the average duration of the domestic bond market as a whole." Other IID funds will often state ranges of duration relative to the Aggregate Bond Index or similar benchmarks.

To examine the relationship between Treasury futures and the duration of these funds, we begin by looking at the extent to which IID fund futures holders and non-holders match the duration of the Aggregate Bond Index using the overall empirical duration of their portfolio as a measure. We show that IID funds are usually well below the duration of the Aggregate Bond Index, but that futures holders tend to be closer than other funds, and are especially close when Treasury futures positions are large, as during these periods their overall empirical duration *increases*. We then examine the duration of the underlying cash portfolio of the funds and show that when futures are more popular the duration of their cash portfolio *decreases*, implying a widening gap between the overall duration of the portfolio and the duration of the cash assets. Indeed, we show this gap is matched by the duration of the futures portfolio. We then provide evidence that the decrease in duration of the cash portfolio is primarily due to changes in the allocations of the funds across asset classes, in turn, attributable largely to transitions from Treasuries to MBS and ABS. Taken together, this suggests that long Treasury futures are being used to fill the gap between the duration of the cash portfolio and the duration of the Aggregate Bond Index created by reallocating from cash Treasuries to agency MBS and ABS.

5.1 Empirical duration

To determine how well different IID funds track the duration of the benchmark, we begin by constructing an empirical measure of duration using fund returns. Using the daily portfolio returns from CRSP, we form a balanced panel of the daily returns of IID funds from 2015 to 2023. We restrict the sample to active funds that list the U.S. Aggregate Index as their benchmark to focus on funds that have the same target but also have at least some incentive to deviate from the allocation of the index. For each fund, we then run daily regressions of fund returns on changes in the 10-year Treasury yield and take the coefficient on the 10-year Treasury yield to be the empirical duration of the fund. We perform the same regression for the Bloomberg Aggregate Index and take the coefficient on the 10-year Treasury yield to be the empirical duration of the index.

The first panel of Table 10 shows statistics of the resulting empirical duration estimates for the full sample, split into the bottom third of futures holders (conditional on futures ownership), the middle third, and the top third. The table reports the average empirical duration of funds in the sample, the difference between the average duration of the fund and the average duration of the index, the average absolute tracking error (the percentage difference between the duration of the fund and of the index), and the share of funds within 1-year of the index. Additionally, we show standard errors for the average duration of the fund inclusive of the first-stage estimation error of the regressions. Finally, we show the difference between high futures holders and funds that do not hold futures, along with the stars denoting the significance of a t-test that the means of the two groups are the same.

For the full sample, duration is generally increasing from funds that use no futures to funds that use high futures. Almost half a year separates the low futures users from the high futures users, and the difference is statistically significant. However, notably at 5.15 years, the duration of the Aggregate Index is higher than the average in any of the groups of funds, for which the highest value is 4.87 years for high futures users. Funds that use more futures are therefore better matched to the index on average. Moreover, they have lower absolute tracking error and shares of funds within one year of the index. This suggests that funds that use futures are better at matching the duration of the index overall.

We next show that during periods with high use of Treasury futures, high futures users track the index better than in periods with low futures use. In the second to fourth panels of Table 10, we estimate the same statistics as in the first panel, but for the years 2019, 2021, and 2023 separately. In 2021, when Treasury futures use was low, absolute tracking errors for futures users were significantly higher and the share of funds with empirical duration within one year of the benchmark duration was significantly lower. The difference in average duration between low, medium, and high futures users was also small and non-monotonic. In 2023, however, high futures users had notably higher average duration, a significantly smaller difference from benchmark duration, and a significantly lower tracking error. Similarly, during the period of high usage in 2019, the difference in average duration from the index was also lower for high Treasury users, and absolute tracking errors and shares within 1-year of the index were also closer.

These findings suggest that during periods of high aggregate long Treasury futures holdings, mutual funds that extensively use futures deviate much less from the target benchmark, both in terms of duration and aggregate returns. These portfolio-level durations are inclusive of the effects of futures. We next examine the duration of the underlying cash portfolio of the funds, as a way of inferring the contribution of futures to the overall duration of the fund.

5.2 Cash portfolio duration

To examine the duration of the underlying cash portfolio of the funds, we again return to the N-PORT data. We obtain CUSIP-level duration data from ICE for a wide range of debt instruments to construct a measure of the duration of the cash portfolio, calculated as the weighted average of the duration of each cash security. Note that these durations differ from the empirical durations in the previous section since they are based on ICE calculations of the theoretical sensitivity to a parallel shift in the yield curve, rather than the actual returns of the assets.[12] Therefore, while the direction of relative changes in duration is likely to be comparable with results in the previous section, the actual levels are not.

In Table 11 we show the weighted-average duration of IID index funds, active funds that do not use futures, and active funds that do use futures, as well as the average durations and weights of the individual asset classes in the category's aggregate cash portfolio. We show these statistics for the same dates as above: December 2019, June 2021, and June 2023.

As with empirical durations, the duration of the cash securities in the index (as proxied by the duration of index funds replicating the index) is higher than the average duration of both futures users and non-futures users throughout the sample period. However, unlike empirical durations, the average duration of the cash portfolio of funds that use futures falls below the duration of the cash portfolio of funds that do not use futures in periods of high futures use, specifically December 2019 and June 2023. As a result, between December 2019 and June 2021, the gap between the cash duration of futures users and the index falls from almost a year (0.97) to roughly four months (0.34) and then rises again to roughly 10 months (0.80) by June 2023. This suggests that high futures use in 2019 and 2023 was associated with a decrease in the duration of the cash portfolio of funds that use futures, and that futures may have filled the gap.

In order to explore the extent to which futures fill a duration gap further, we calculate the duration of the funds' cash portfolio along with their futures position. While the futures position adds little to the duration of index funds or non-futures holders, it adds over a year to the duration of futures holders in 2019 and about 10 months in 2023. As a result, the futures portfolio of these funds nearly perfectly fills the gap between the durations of the fund and of the index throughout these periods. The full time-series of these two measures for IID futures-users is shown in Figure 10, where we can see that in the aggregate the rise in duration from futures coincides with the decline in cash duration, and fills the gap between cash duration of futures-users and index funds.

In Table 12, we examine cash duration and futures duration in the panel of IID funds. We

[12] Ideally we would use the same measure for both the cash and the empirical duration, but constructing a measure of the empirical duration of the cash portfolio is difficult due both to the difficulty of assembling daily returns and the question of how to deal with the need to roll over maturing securities on an intra-quarter basis when constructing daily returns with only quarterly data on holdings. Without this ability, we would be limited to quarterly duration estimates that would not be reliable given the short period for which we have N-PORT data.

regress the change in the duration of their cash portfolio on the change in the duration of their futures. If IID funds were perfectly filling the gap between cash and futures we would expect a coefficient of -1, since the change in the duration of the cash portfolio would be exactly offset by the change in the duration of the futures portfolio. Across specifications, including both time and fund fixed effects, we find a coefficient of roughly -0.4. While not perfectly offsetting, this strongly suggests a gap-filling motive to futures use, but leaves open the question of where the gap between the duration of the funds and their index comes from.

To begin explaining the emergence of this duration gap, we note that for futures holders (and active non-futures holders), the highest duration asset class is U.S. Treasuries. The duration of U.S. Treasuries held by these funds is also higher than the duration of U.S. Treasuries held by the index funds, consistent with the lower allocation towards short-maturity Treasuries noted above.[13] Meanwhile, ABS and MBS assets have the lowest durations of any asset class for futures holders. Therefore, the reallocation from cash Treasuries to ABS and MBS is likely associated with a decrease in the overall duration of the cash portfolio. Additionally, the duration of the cash portfolio could change because of changes in the duration of the underlying assets, due to changes in aggregate interest rates, or from changes in the composition of the individual securities within the asset class.

To separate these effects, we perform a partial decomposition of the change in the duration of the cash portfolio of each fund class into a component due to changes in the duration of the underlying assets and a component due to changes in the allocation of capital across asset classes. More specifically, the average weighted average duration of each group of funds can be written as:

$$\Delta\left(\sum_i p_{i,t}\sum_j w_{i,j,t}D_{i,j,t}\right) = \sum_i p_{i,t}\sum \Delta w_{i,j,t}D_{i,j,t} + \sum_i p_{i,t}\sum_j w_{i,j,t}\Delta D_{i,j,t} + \sum_i p_{i,t}\sum_j D_{i,j,t}w_{i,j,t}D_{i,j,t},$$

where i denotes the fund, j denotes the asset class, $p_{i,t}$ is the share of the fund in all IID assets, $w_{i,j,t}$ is the weight of asset class j in fund i's portfolio as of time t, and $D_{i,j,t}$ is the duration of

[13] Anecdotally, long maturity U.S. Treasuries are often used by these funds to gain duration exposure, because similar maturity corporate securities are harder to find and because the duration of MBS is usually quite shorter due to the prepayment option. Longer maturity Treasuries in this case may stay on futures holder balance sheets since they are the most difficult to replicate either with other holdings or with futures.

asset class j in fund i's portfolio as of time t. The first term on the right-hand side is the change in the duration of the cash portfolio due to changes in the allocation of the fund across asset classes; the second term is the change in the duration of the cash portfolio due to changes in the duration of the underlying assets; and, the third term is the level of the duration of the cash portfolio. We calculate these changes keeping the 2021 portfolio as a baseline and show the results in Table 13. The row labeled "2021 allocations" corresponds to changes due to the duration of the underlying assets, whereas "2021 durations" correspond to changes due to the allocation of the funds across asset classes.

We find that the change in the duration of the cash portfolio of funds that use futures is primarily due to changes in the allocation of capital across asset classes. This is in contrast to changes in the duration of the index, which are driven almost entirely by changes in the duration of the underlying holdings. To further investigate the drivers of this shift we construct a hypothetical change in duration from only the changes in the allocation of funds from agency MBS to U.S. Treasuries as:

$$\sum_i p_{i,t} \times \Delta w_{i,\text{MBS},t} \times (D_{i,\text{MBS},t} - D_{i,\text{UST},t}).$$

These results are reported in the row "Agency MBS only". While index funds have virtually no change in this measure, futures holders have the largest changes out of all three funds, accounting for more than 100% of the total changes in duration due to allocation changes. This suggests that the reallocation from MBS to U.S. Treasuries is the primary driver of the decrease in the duration of the cash portfolio of funds that use futures.

Next, we decompose changes in cash duration into asset-class level effects in Table 14. Each dependent variable is constructed as:

$$\sum_i \Delta w_{i,j,t} \times (D_{i,j,t} - \tilde{D}_{i,t}).$$

where $\tilde{D}_{i,t}$ is the weighted average duration of fund i at time t. This effectively measures a counterfactual change in duration that would result if duration within the asset class had remained constant and capital was drawn equally from all asset classes into class j. As before, the independent variable is the ratio of long Treasury futures notional value to AUM, with both fund and time fixed effects and only for active funds, as in the previous section.

Table 14 shows that reallocations away from Treasuries and towards agency, private-label debt and CDOs contributed substantially towards the overall decrease in durations due to changes in asset allocation. Meanwhile, allocations to corporate debt actually increased the duration of the funds. In Appendix Table A.4, we find an insignificant relationship between Treasury futures allocations and the overall duration of the fund. However, when only the changes in duration due to changes in portfolio allocations across asset classes are considered, the relationship becomes large and statistically significant.

Taken together, the evidence in this section is consistent with funds using futures to fill a gap between the duration of their cash portfolios and the duration of the index they track, created by reallocating from cash Treasuries into MBS and ABS. However, this does not establish why funds would want to make this reallocation at certain times. In the next section, we examine the cyclical incentives for funds to invest in MBS.

6 Alternative explanations

The preceding sections have presented evidence consistent with the following: (1) funds use futures to target duration when the gaps between their benchmark and the duration of their cash portfolios are large, (2) that these gaps are commonly caused by their reallocation from Treasuries to MBS, and (3) that this reallocation, in turn, may be due to cyclical variation in the attractiveness of MBS relative to Treasuries. This channel is what we refer to as "reaching for duration," with funds chasing higher returns on MBS by tilting away from their index but using futures to maintain their duration target.

It is worth considering a few alternative explanations for the variation in Treasury futures and whether we can reject them based on these results. One possibility is that funds are using Treasury futures to hedge against interest rate risk. However, Treasury futures appear to be actually increasing their duration and therefore boosting the variance of their fund returns rather than reducing them. Therefore, while the behavior of these futures users does bring them into closer alignment with their target index, it does not reduce the overall risk of their portfolio as would be expected with conventional hedging.

Another possibility is that funds use Treasury futures to generally increase the risk of their portfolio for speculative purposes. While this cannot be eliminated, we note that these funds, in general, are *less* volatile than their target benchmark, which suggests that their risk-taking is not excessive relative to what they promise investors. Moreover, we find no evidence that these funds are tilting towards conventional risky assets such as speculative-grade debt. While the funds do take on more repayment risk than their benchmark, they are therefore not taking on greater credit risk.

A related possibility is that funds use futures to bet on the level of interest rates or changes in the slope of the yield curve. Again, this is difficult to eliminate, and the incentives to tilt toward MBS will be related to the level and slope of the yield curve through the prepayment option given to borrowers. However, it seems unlikely that funds are using futures alone to construct artificial steepeners or flatteners. As discussed above, the d futures positions that funds hold are largely one-sided, even when adjusted for duration. Therefore, these positions cannot be pure yield-curve bets constructed using futures since the funds are substantially net long in all contracts. On the other hand, yield-curve trades could be constructed using cash securities and futures of different maturities. This can also be eliminated for the majority of futures positions since we find that futures users are selling short-maturity Treasury positions, which would then match the duration of the predominately 2-year and 5-year futures positions they are being replaced with. If funds were instead speculating on changes in the yield curve, we would instead see that the duration of the cash positions being sold would be longer than the duration of the futures positions being bought.

Lastly, funds may increase their futures use to save cash to meet potential redemptions while tracking their benchmark index. This explanation would be closely related to reaching for duration since it would represent a shift from high-duration to low-duration cash assets, but distinct in that cash assets are generally lower-yield than Treasuries. We do see a slight increase in cash holdings in the final column of Table 6, but it is not significant.

The prior sections have examined the time-series variation in Treasury futures positions of mutual funds. Next, we explore cross-sectional heterogeneity and offer some preliminary evidence for its source.

7 Cross-sectional heterogeneity

A natural question arises from the preceding sections. Why do some funds use Treasury futures while others do not? In this section, we examine the cross-sectional variation in Treasury futures use among intermediate investment-grade debt funds. We find that funds that use Treasury futures appear to be differentiated from other funds. There is little difference in returns between futures holders and non-holders. However, flows of futures holders are less sensitive to performance than their other active peers, suggesting investors may be attracted to their ability to track their duration benchmarks. Many of these funds also have specific wording in their prospectuses mentioning their ability to use derivatives.

Meanwhile, consistent with the above discussion of reaching for duration, futures users are more likely to be in Lipper objective codes where the index funds in the same code have a higher allocation to Treasuries. They also tend to mention duration and words associated with mortgage-backed securities in their prospectuses. Finally, futures users are also more likely to state "total return" as their objective and have significantly higher turnover ratios.

7.1 Flows and Performance

Next, we turn to the incentives faced by fund managers. Mutual funds earn fees based on assets under management, and managers are incentivized to maximize assets under management in order to maximize fee income. A rich literature examines the relationship between flows and performance (Berk and Green (2004), Coval and Stafford (2007)). In this section, we examine whether the association between flows and performance differs between funds that hold Treasury futures and those that do not.

First, we discuss the performance of these funds. Table 16 shows that there is little difference in the average performance of funds that hold Treasury futures and those that do not, nor among funds that hold different amounts of Treasury futures. However, all funds out perform the Aggregate Bond Index, which is consistent with the lower allocation to Treasuries of both futures-users and non-futures-users. This pattern continues when we examine portfolio alpha in the third column. That funds that use derivatives do not outperform funds using derivatives is consistent with previous results in Koski and Pontiff (1999), Fong et al. (2005), and Cao et al. (2011).

Meanwhile, the fourth column shows that higher futures holders are generally more risky than lower futures holders, as measured by the standard deviation of their returns. This is accounted for by the higher duration of futures holders, as shown in the previous section. The final column of this table shows this concretely using the standard deviation of the fitted returns from the regression of fund returns on the 10-year Treasury yield as a measure of the raw "duration component" of risk.

That futures holders continue to operate with similar returns, but higher risk, is puzzling, we show that it is explained by a different flow-performance relationship for futures holders and non-holders. Table 21 regresses quarterly percentage fund flows on one-quarter lagged returns, indicators for Treasury futures ownership, and their interaction, along with other controls. Flows are calculated as $\left[AUM_{i,q} - (1 + R_{i,q}) \times AUM_{i,q-1}\right]/AUM_{i,q-1}$, where $AUM_{i,q}$ is assets under management for fund i in quarter q and $R_{i,q}$ is the quarterly return for fund i earned between quarters $q - 1$ and q. Controls include the log of total AUM, sales restrictions (as reported in CRSP), and indicators for whether the fund is currently open to investors and whether the fund is a retail fund.

Column (1) of Table 21 shows the results of quarterly percentage flows regressed futures ownership, the one-quarter lagged (quarterly) return, and their interactions. Log (lagged) net assets under management are included as a control. As expected, the lagged quarterly return is strongly related to flows. A one percentage point higher return in the previous quarter is associated with a 0.58 greater percentage point inflow in that quarter. Further, all three categories of Treasury futures investors (bottom third — "Low futures"; middle third — "Medium futures"; and top third — "High futures") show a negative interaction coefficient, with the coefficient on high-futures being statistically significant at the 5% level. In columns (2) and (3), we find similar quantitative results when controls, time fixed effects, and fund fixed effects are included. In each case, funds that are the heaviest users of Treasury futures display a weaker flow-performance relationship than funds that don't use Treasury futures at all.

The findings in Table 21 make sense if investors choose to invest in funds that use derivatives because they can more closely adhere to the aggregate benchmark return. Table 10 showed that futures holders do indeed demonstrate smaller tracking errors and a closer connection to benchmark duration. In this case, investors in funds with greater futures holdings (and in turn better index tracking) respond less to performance because a greater portion of the fund's return is tied to the performance of the benchmark, which is out of the fund's control and ultimately the exposure investors presumably want in the first place. Said differently, the value of funds investing in futures is that during periods of attractive near-substitutes for Treasuries, such as MBS, these funds can shift into such assets while maintaining a tighter link to the aggregate bond market index.

7.2 Investment policies and derivatives constraints

One possible explanation for the cross-sectional difference in Treasury futures use among IID mutual funds is explicit constraints that prohibit, or strongly restrict, the ability of some funds to use derivatives. Below, we provide evidence in support of such constraints being binding for some funds. Then, we show that particular fund characteristics, independent of information from fund prospectuses, can explain variation in Treasury futures usage.

First, we sort funds into four groups as of June 2023: funds that invest in both Treasury futures and other derivatives, funds that invest in Treasury futures but not other derivatives, funds that invest in other derivatives and not Treasury futures, and funds that invest in neither Treasury futures nor other derivatives. We find that among funds that hold no Treasury futures, 73% also hold no other derivatives. This is strong evidence in support of implicit or explicit constraints on derivatives usage. Seemingly, many funds simply do not invest in derivatives of any type. Such a restriction will likely be explicated in the fund's prospectus, and we discuss suggestive evidence from these prospectuses below. Further, among Treasury futures holders, 73% invest in other derivatives, further supporting the hypothesis that funds to a large degree segment into those that may (and often will) use derivatives and those that will not. Across all funds, 37% hold some form of derivatives.

Next, we turn to fund prospectuses. One source of explicit fund constraints on the ability to use derivatives comes from funds' stated investment strategy via their prospectuses to investors. Prospectuses are legally binding documents, and funds must adhere to the policies set out in their offering documents. In their prospectuses, funds generally describe their investment mandate along with tools for achieving that mandate, including the extent to which they will employ traditional leverage (e.g. borrowing on margin or in repo markets) or will use derivatives.

The first two columns of Table 17 report the percentage of funds that discuss derivatives in the "Principal Strategies" section of their prospectuses. Across all fund types, only 36% of funds that don't hold any Treasury futures as June 2023 mention "derivatives". Comparatively, this percentage is near or above 80% for funds that hold Treasury futures. Restricting the sample to IID funds, Table 17 shows that around half of non-futures users mention derivatives, but 95% of high futures users mention derivatives. p-values are reported for null that there is no difference between non-futures holders and the largest futures holders and are minuscule. Columns (3) and (4) of Table 17 conduct a similar analysis for the "Principal Risks" section of the prospectus. As in columns (1) and (2), "derivatives" are mentioned nearly twice as often for Treasury futures holders as non-futures holders.

Table 18 offers an alternative view of mutual fund strategies outlined in their prospectuses. Table 18 shows the twenty words most predictive of positive Treasury futures positions. The most common words reported for futures users are "mortgage", "backed", and "debt." The commonality of MBS-related words within fund prospectuses is strongly supportive of our earlier findings that funds that use Treasury futures shift out of cash Treasuries and into MBS when the relative attractiveness of MBS spreads is high. The explicit mention of MBS-related terms further suggests these funds view MBS as close substitutes of cash Treasuries and intend for MBS to be a consistent part of their investment strategy. Other words associated with interest rate risk are also common: "duration", "swaps", "dollar", and "inflation". These common words offer further supportive evidence of the hypothesis that mutual funds that use Treasury futures do so to target interest risks while shifting assets away from cash Treasury securities and into higher-yielding assets.

7.3 Fund Characteristics

Funds' descriptions of derivatives use in their prospectuses effectively tie the hands of mutual fund managers. An open question remains, however, why some funds would restrict themselves in such a manner. Or, why wouldn't all funds restrict themselves in such a manner? In this section, we examine whether particular fund characteristics are associated with variation in long Treasury futures use, independent of restrictions in fund prospectuses.

Table 19 regresses an indicator for whether the fund holds long Treasury futures on a set of fund characteristics.[14] The first column conducts this regression for only IID funds, while the remaining three columns include all funds, regardless of investment style. In the second column, one of the most important predictors of Treasury futures investments across fund styles is the index Treasury share, which is the share of Treasuries in all index funds in the same fund style. We use this as an indicator of the likely allocation of Treasuries for the funds' benchmark index. In terms of magnitude, a 1 percentage point increase in this Treasury share is associated with a *26%* increase in the likelihood of the fund using long Treasuries. Similarly, Table A.6 shows that a 1 percentage point increase in the Treasury share corresponds to an 8 percentage point increase in Treasury futures notional to assets. This again illustrates the key importance of the large allocation of the benchmark in driving mutual funds' Treasury futures use.

Additionally, the second column of Table 19 finds that funds that mention either "mortgage" or "duration" in the principal strategies section of their prospectuses are more likely to own Treasury futures across styles. The importance of duration in the funds' strategy statement is consistent with the incentive to match the duration of an index, while mortgage-backed securities use as we have shown is a key alternative to Treasury holdings for these funds. Collectively, these variables explain much of the variation across fund styles, as adding fund style dummies in the third column only adds roughly 8% to the R^2 of the regression.

Other fund features have strong explanatory power both in and across funds. Funds that trade more, as measured by their turnover ratio, or that have a total return objective are more likely to hold long Treasury futures. A focus on total return may mean the fund is more likely to take on positions in response to temporary market conditions, such as if MBS are attractive relative to Treasuries. Trading frequently would be consistent with this strategy as well, and would also mean that dealing with off-the-run Treasuries could be costly for the fund. This stands in contrast to index funds, which may be better able to hold positions including off-the-run Treasuries for the long term. Funds that use Treasuries are more likely to mention leverage as a risk in their prospectus, again pointing towards the salience of futures use for investors.

Finally, large funds are more likely to use futures, which may point to economies of scale. This

[14] In the appendix, Table A.6 conducts a similar exercise for futures as a percent of total assets, with very similar results.

is reinforced by the fact that advisor fixed effects add significantly to the explanatory power of the regression in the fourth column. This is consistent with the prevalence of long futures positions among the funds of certain asset managers. In both cases, it may suggest the importance of having managers with experience with futures markets who are able to use derivatives effectively to manage duration.

7.4 Flows and futures use

Table 19 showed that certain fund characteristics are associated with the decision to invest in Treasury futures. Next, we examine whether Treasury futures holdings are associated with fund flows. Here, we focus on characteristics of flows independent of their association with returns, and study the flow-performance relationship and its association with flows in a later section. We hypothesize three separate mechanisms that may link flows to Treasury futures positions. First, it may be funds that have greater flow volatility are more likely to hold Treasury futures. Because Treasury futures tend to be more liquid than cash Treasuries, particularly off-the-run Treasuries, funds with greater flow volatility may use futures as a way to manage liquidity costs in response unexpectedly large inflows our outflows. Second, funds that experienced particularly large outflows during the Covid pandemic may have greater incentives to outperform the benchmark and "reach for yield", leading such funds to use Treasury futures as leverage to magnify performance. Lastly, large inflows during the Covid recovery period may force funds to tilt away from cash Treasuries and toward Treasury futures if the cost of holding larger amounts of Treasuries are sufficiently high, or conversely, if weaker inflows during the recovery period may further incentivize reaching for yield.

Table 20 investigates each of these possibilities. We find no evidence that any of the three mechanisms are important factors for the growth or size of Treasury futures positions. We focus on "IID" funds only for comparability of estimates, though results are similar when we include all fund types and a fixed effect for fund type.

Columns (1) and (2) reports results from cross-sectional regressions of an indicator for whether the fund holds Treasury futures as of June 2023 on the volatility of fund flows prior to 2018. We restrict to observations prior to 2018 because 2018 is when the first build-up of long Treasury futures positions by asset managers began. Column (1) is an unconditional regression and column (2) includes as controls the same covariates included in Table [17]. In each regression, we find a negative and statistically insignificant coefficient, suggesting higher flow volatility would be associated with a *lower* probability of investing Treasury futures. We find similar results when we use the volatility of flows prior to 2023.

In columns (3) and (4), we estimate panel regressions of long Treasury futures ownership in June 2023 on the average percentage fund flow between January 2020 and December 2021, which we roughly identify as the Covid crisis period. The sign of the coefficient is negative in both specifications, consistent with a "reaching for yield" motive, however we note the coefficient is statistically insignificant. Similarly, in columns (5) and (6), we examine whether average flows during the Covid recovery period, which we define as the entirety of 2022, are associated with the probability of investing in Treasury futures. As with the other specifications, we again find no statistically significant association between average flows in 2022 and the likelihood of holding Treasury futures, though we note that as in columns (3) and (4), the coefficient estimates are negative, consistent with potential reaching for yield. In total, while coefficient signs may suggest some incentive to hold Treasury futures in response to larger outflows or weaker inflows, we find no statistical evidence of an effect of the level or volatility of flows on the likelihood of investment in Treasury futures positions.

8 Discussion

8.1 Alternative means of Treasury leverage

In this section, we answer another related question: given that funds want to pursue higher returns by tilting towards MBS, why do they use Treasury futures to do so, as opposed to other means of securing levered duration such as repo or swaps?

One way to replicate a Treasury without using a futures contract or significant balance sheet space is to borrow against the Treasury in the repo market. These two strategies (long futures versus cash Treasury borrowed in the repo market) are not perfect substitutes, but they do make up the two legs of the cash-futures basis trade. In fact, as shown in Barth and Kahn (2021), the recent periods where asset managers have been most active in the Treasury futures market have been associated with a relatively high cash-futures basis. This suggests that it would be cheaper for mutual funds to secure their Treasury leverage by buying the Treasury and borrowing through repo than it is to use futures. Moreover, while funds use of Treasury repo was previously separately limited, under SEC rule 18f-4, which was adopted in 2020, repo and futures are subject to the same VaR-based leverage limit, meaning that there is no additional regulatory limit applied to repo.

It is therefore somewhat surprising that, as Table 22 shows, while 9% of all funds and 51% of IID funds have long Treasury futures positions, only about 0.5% of all funds and 1% of IID funds use repo. To shed some light on why, in Table 22, we split both IID funds and all funds into those that did and did not use Treasury futures as of June 2023, and those that did or did not borrow in the repo market. We note that, although repo is treated similarly by regulators, it is often disclosed separately in the risks and strategies section. Moreover, while some funds that use futures do not mention leverage as a risk, nearly all funds that use repo mention leverage as a risk. This suggests that repo may have a stigma attached to it that futures do not. Given that 18f-4 was only adopted recently, and that it takes time for new rules to percolate through the industry, it is possible that repo use will increase and futures use decrease as time goes on.

Another factor is that futures are simpler than repos. Dealer-to-customer repo transactions lack transparency, making it difficult to negotiate a fair price and meaning that repo market pricing is often dependent on relationships.[15] In contrast, Treasury futures are traded electronically on transparent screens with very low transaction costs. Similarly, central clearing for dealer-to-customer repo trades, while growing, is also limited. As discussed in Kahn and Olson (2021), nearly all the volume from customers borrowing in the cleared markets is from hedge funds. This means that repo borrowing by mutual funds would have to take place through non-centrally cleared repo, and potentially involve counterparty risk not present in the centrally-cleared futures market.

Finally, we consider the use of swaps. Swaps are another way to secure levered duration, and they are often used by funds that want to take on interest rate risk. In Table A.13, we consider a similar split to the split for repo borrowing on the use of interest-rate swaps. Interest-rate swaps

[15] See Clark et al. (2021) and Kahn et al. (2023) for discussions of transparency and transaction costs in the dealer-to-customer market. For the value of relationships see Han et al. (2022). Several studies, such as Anbil et al. (2021) and Eisenschmidt et al. (2024) point to dispersion in these markets that may be related to this lack of transparency and reliance on relationships.

are much more popular than repo borrowing, with 3% of all funds and 23% of IID funds using swaps. They also appear to be considered comparably risky to futures based on their mentions in the risks and strategies sections of the prospectuses of swaps users. However, the notional amounts involved for IID funds, while large relative to the total assets of the fund are not nearly as large when considered in the context of the average swap user overall. Therefore, either the bespoke nature of the OTC swaps market or the relatively high transaction costs of swaps compared to futures may be limiting their use by funds that are more active in Treasury futures.

8.2 Treasury inconvenience

The results above suggest that mutual funds use Treasury futures to replicate the duration exposures of Treasuries while using their balance sheet to hold other assets. Why should mutual funds want to avoid holding cash Treasuries? One key reason suggested above is the relatively low yields offered by Treasuries. However, there may be additional costs from the type of Treasuries in the index. Table 23 shows the holdings of IID index funds, non-futures holders, and futures holders by run-status of the Treasury. The vast majority (85% as of June 2021) of Treasuries held by index funds we classify as "deep off-the-run", meaning Treasuries that were first issued over a year ago, and have usually been held for a substantial length of time.

In contrast with index funds, but consistent with the apparent focus of futures holders on high-turnover investments, much of the Treasury holdings of futures holders (55% as of June 2021) are either highly liquid on-the-run securities or relatively recent off-the-run securities issued within the last year to year-and-a-half. This suggests that funds that use futures may face higher costs, broadly defined, to transact in the off-the-run market, and therefore may not be able to easily secure the Treasury needed to use repo to replicate the index. Replicating an index with deep off-the-run Treasuries is especially expensive for funds that trade regularly as part of their investment strategy, and therefore may have to buy or sell these Treasuries as part of their regular business. This may be another reason why turnover is associated with higher Treasury futures use.

Meanwhile, much of the MBS investments of futures holders are in relatively liquid TBA contracts (roughly 50% as of June 2021). Again this is consistent with the high-turnover nature of futures holders. But it also may provide another reason why Treasury futures are attractive. One of the key difficulties in using Treasury futures is the complicated nature of the delivery process.[16] While the process may be opaque to some investors, in some ways, it is very similar to the delivery process for the TBA market, so this may make futures relatively easier for these funds to use.

Regardless of whether the cost is solely due to the low yield on Treasuries or due to the difficulty of trading off-the-run Treasuries, it is likely this cost rises with the share of Treasuries in the index. With the light blue line in Figure 12 we show that the share of Treasuries in the Bloomberg Aggregate Index has been increasing over time, using the iShares Core US Aggregate ETF as a proxy. The index has risen from roughly 35% in early 2010 to almost 45% in 2023, even though as we show most of the funds targeting this index have remained well below this allocation to Treasuries. This in turn increases the tension between the Aggregate Index duration and the duration of the funds that leads to the use of futures to reach for duration.

The Aggregate Index in turn has an important relationship to outstanding Treasury debt. The allocation of the index to Treasuries is largely determined by the share of total Treasuries, less Federal Reserve holdings of Treasuries, in total debt. We show this in the dark blue line in Figure 12, using data from the financial accounts and monthly statements of the public debt.[17] As this figure shows, issuance since the 2008 financial crisis increased the share of Treasury debt in the Aggregate Index, while Federal Reserve purchases of Treasury debt in 2020 more than offset the effect of the increases in Treasury debt since the COVID crisis into 2022, tightening has begun to increase the share in the Aggregate Index again. Going forward increases in Treasury debt may lead to increases in the Aggregate Index allocation to Treasuries, with the consequence of higher mutual fund holdings of Treasury futures.

9 Conclusion

We show that the substantial magnitudes and time-series variation in long Treasury futures positions are driven in large part by asset manager positions. Mutual funds in particular appear to be a significant source of this variation. We show further that Treasury futures positions are substitutes for cash Treasuries, rather than complements, and free up cash for mutual funds to invest

[16]See Burghardt and Belton (2005) for details.

[17]Specifically, we use total marketable Treasury debt held by the public less SOMA Treasury holdings over the sum of corporate debt, agency debt and Treasury debt.

in other assets. In particular, we show that when Treasury futures positions of mutual funds are high, mutual funds shift away from cash Treasuries and into MBS and other asset-backed securities, specifically CDOs. This shift pushes funds away from their duration targets, and funds use Treasury futures to maintain these targets during times when other assets — MBS and CDOs — are particularly attractive. In doing so, funds manage their dual objectives of achieving high total returns while staying near the duration of the aggregate bond market.

Treasury futures reduce the cost of meeting benchmark index durations for mutual funds. By allowing these funds to hold fewer Treasuries and more mortgage-backed securities, mutual funds can provide better returns to investors. They also enable funds to indirectly provide funding and liquidity to the mortgage market. This role has become more important as the indexes that fixed-income funds are benchmarked against have become more heavily allocated towards Treasuries and may become even more important in the future if Treasury borrowing continues at the same pace.

While these services are beneficial, the use of Treasury futures by mutual funds also introduces leverage into Treasury markets, both directly and indirectly. First, mutual funds that reduce positions in cash Treasuries and reallocate toward MBS and ABS may take on additional sources of risk in their cash portfolios. MBS and ABS are, in general, lower duration, but they have additional prepayment risk. Moreover, because Treasury futures require less cash up front they constitute a leveraged position in Treasuries. This introduces funds to cash flow risk through the threat of margin calls that are not present when funds hold cash Treasuries rather than futures, which may magnify instability in Treasury markets if these funds are forced to reduce their positions quickly.

Additionally, hedge funds are the primary traders opposite mutual funds in Treasury futures markets, taking the short positions that prior research suggests are in service of the cash-futures basis trade. The basis trade pairs a short Treasury futures contract with a long cash Treasury position, financed in repo. The trade is relatively low return, however, and hedge funds correspondingly apply significant leverage. Because this leveraged trade results from mutual funds' demand for long Treasury futures, an indirect consequence of mutual funds' demand for futures positions is the associated Treasury market leverage introduced through hedge funds. Both of these sources of leverage may present increased risks to Treasury markets, as materialized during March 2020.

This paper documents a novel channel through which asset managers may affect core bond markets. In managing their dual objectives of generating returns for investors while matching a benchmark index duration, mutual funds' reach-for-duration incentive drives greater leverage in the Treasury market. Though we have already seen important consequences of large Treasury futures holdings in the events leading up to March 2020, this activity may become increasingly important for dynamics in Treasury markets in the years to come.

	Dec 2019	Jun 2021	Jun 2023	Dec 2019 to Jun 2021	Jun 2021 to Jun 2023
			Total		
All asset managers	888	682	1087	-206	405
Mutual funds	503	362	583	-141	221
			2-year		
All asset managers	347	166	346	-181	180
Mutual funds	190	122	259	-68	137
			5-year		
All asset managers	221	187	250	-34	63
Mutual funds	172	108	163	-64	55
			10-year		
All asset managers	162	159	252	-3	93
Mutual funds	77	72	92	-5	20
			10-year Ultra		
All asset managers	31	47	82	16	35
Mutual funds	16	9	21	-7	12
			30-year		
All asset managers	51	56	69	5	13
Mutual funds	15	25	17	10	-8
			30-year Ultra		
All asset managers	73	64	86	-9	22
Mutual funds	30	23	28	-7	5

Table 1: **Notional long Treasury futures of all asset managers and mutual funds:** The table shows the notional amount of Treasury futures held by all asset managers (from the CFTC's Traders in Financial Futures data) and mutual funds (from Form N-PORT) at the end of December 2019, June 2021, and June 2023. The last two columns show the change in notional amount from December 2019 to June 2021 and from June 2021 to June 2023.

	Dec 2019	Jun 2021	Jun 2023	Dec 2019 to Jun 2021	Jun 2021 to Jun 2023
Total assets:	25,048	31,834	29,611	6,785	-2,222
Total long futures:	503	362	583	-140	221
			Intermediate Investment Grade Debt		
Total assets	1,677	2,088	1,931	410	-156
Long futures	191	118	190	-72	71
Share of all futures	38	32	32	-5	0
			Short Investment Grade Debt Funds		
Total assets	347	422	354	74	-67
Long futures	28	51	48	22	-2
Share of all futures	5	14	8	8	-5
			Balanced		
Total assets	857	978	486	120	-491
Long futures	23	14	44	-9	30
Share of all futures	4	3	7	0	3
			Short Intermediate Investment Grade Debt		
Total assets	149	233	206	84	-26
Long futures	17	9	25	-8	16
Share of all futures	3	2	4	-1	1
			Growth and Income		
Total assets	3,540	4,509	6,243	969	1,733
Long futures	7	8	23	1	15
Share of all futures	1	2	4	0	1

Table 2: **Notional long Treasury futures of mutual funds by Lipper objective codes:** The table shows the total assets and notional amount of Treasury futures held by mutual funds at the end of December 2019, June 2021 by Lipper objective code along with the share of the code in total mutual fund Treasury futures. The last two columns show the change from June 2021 to June 2023.

	% positive	Percentiles 1%	10%	25%	50%	75%	90%	99%
					$ billions			
Total	**10**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.002**	**0.81**
Intermediate Investment Grade Debt	54	0.0	0.0	0.0	0.003	0.144	0.587	15.086
Short Investment Grade Debt Funds	50	0.0	0.0	0.0	0.002	0.144	0.502	3.126
Balanced	24	0.0	0.0	0.0	0.0	0.0	0.063	1.979
Short Intermediate Investment Grade Debt	39	0.0	0.0	0.0	0.0	0.068	0.361	7.277
Growth and Income	6	0.0	0.0	0.0	0.0	0.0	0.0	0.144
					% of net assets			
Total	**10**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.915**	**41.366**
Intermediate Investment Grade Debt	54	0.0	0.0	0.0	2.473	19.515	32.056	125.441
Short Investment Grade Debt Funds	50	0.0	0.0	0.0	0.902	23.951	47.335	74.464
Balanced	24	0.0	0.0	0.0	0.0	0.0	6.978	18.476
Short Intermediate Investment Grade Debt	39	0.0	0.0	0.0	0.0	18.59	29.084	61.774
Growth and Income	6	0.0	0.0	0.0	0.0	0.0	0.0	6.886

Table 3: **Variation in notional long Treasury futures of mutual funds by Lipper objective codes:** The table shows percentiles of the notional amount of Treasury futures held by mutual funds at the end of June 2023 by Lipper objective code along with the share of funds in each objective code with positive long Treasury futures holdings. Results are shown for the top five codes. The first set of rows show the percentiles for billions of notional dollars, while the final set of rows show the percentiles for percent of net assets.

Fund name	Net assets	Long futures positions $ billions Jun 2023	Jun 2021	Dec 2019	% assets Jun 2023	Jun 2021	Dec 2019
American Balanced	202	34	7	17	16	3	10
Bond Fund of America*	75	31	9	18	41	13	38
American Funds Strategic Bond*	17	28	0	0	158	0	27
Metropolitan West Total Return Bond*	62	23	2	12	37	2	15
Lord Abbett Short Duration Income	46	22	21	5	47	35	9
Western Asset Core Plus Bond*	24	17	13	29	72	31	94
Intermediate Bond Fund of America	24	17	2	7	71	9	33
U.S. Government Securities	19	14	0	7	74	2	46
American Funds Inflation Linked Bond	13	11	1	1	84	9	27
PGIM Total Return Bond*	40	8	18	28	21	30	57

Table 4: **Top 10 holders of long notional Treasury futures in June 2023:** The table shows the total assets, notional amount of Treasury futures at the end of December 2019, June 2021, and share of Treasury futures in total net assets for the top 10 holders as of June 2023. Stars denote funds classified as having an intermediate investment grade debt objective by Lipper.

Asset class	Percent of total assets: Index funds Dec 2019	Jun 2021	Jun 2023	Non-futures holders Dec 2019	Jun 2021	Jun 2023	Futures holders Dec 2019	Jun 2021	Jun 2023
Treasuries	42	40	43	24	22	21	22	28	23
$<$ 5 YTM	25	23	25	10	9	7	11	16	9
5-10 YTM	9	9	10	8	7	5	5	5	6
$>$10 YTM	8	8	8	7	6	9	6	8	8
MBS	25	23	23	29	23	27	44	27	39
Agency	25	22	22	24	18	22	34	19	32
Private label	0	1	1	4	5	5	10	8	8
Corporate debt	28	31	29	33	39	37	31	32	31
Investment-grade	27	30	28	28	32	34	25	25	25
Speculative-grade	1	1	1	5	7	4	6	7	6
U.S. borrower	22	25	23	25	30	29	22	24	23
Non-U.S. borrower	6	6	6	8	9	9	9	8	7
CDO	0	0	0	2	2	3	4	5	5
Other ABS	0	0	0	5	7	5	3	3	4
Non-US sovereign debt	2	2	2	1	2	1	4	3	2
Other	3	3	3	6	6	6	-8	2	-3

Table 5: **Holdings of intermediate investment grade debt funds:** The table shows the share of each asset class in the total assets of intermediate investment grade debt funds as classified by Lipper in December 2019, June 2021 and June 2023. The sample is split into index funds and active funds that hold long futures and those that do not.

Panel A: IID Funds	Treasuries (cash)	MBS	Corporate Debt	Other ABS	Cash
Treasury futures to assets	-0.125^{***}	0.047^{***}	0.008	0.040^{***}	0.014
	(0.015)	(0.013)	(0.009)	(0.008)	(0.014)
Fund fixed effect	X	X	X	X	X
Time fixed effect	X	X	X	X	X
R^2	0.811	0.867	0.858	0.873	0.65
Observations	4,402	4,402	4,402	4,402	4,402
Panel B: All funds	Treasuries (cash)	MBS	Corporate Debt	Other ABS	Equity
Treasury futures to assets	-0.053^{***}	0.004^{***}	-0.005^{***}	0.004^{***}	0.028^{***}
	(0.007)	(0.003)	(0.002)	(0.002)	(0.008)
Fund fixed effect	X	X	X	X	X
Time $\times$ objective fixed effect	X	X	X	X	X
R^2	0.93	0.956	0.982	0.931	0.976
Observations	183,594	183,594	183,594	183,594	183,594

Table 6: **Regression of portfolio share in cash assets on Treasury futures share.** The table shows results of quarterly regressions of holdings of certain asset classes on Treasury futures notional positions. All variables are normalized by fund assets. Panel A shows results for intermediate investment-grade debt (IID) funds and Panel B shows results for all funds. Results use N-PORT data from December 2019 to September 2023. ABS includes collateralized debt obligations, asset-backed commercial paper and other ABS, but excludes MBS. All regressions include fund and time fixed effects. Standard errors are in parentheses. * indicates significance at the 10% level, ** at the 5% level, and *** at the 1% level.

	Fixed	Floating	Variable
Treasury futures to assets	-0.090^{***}	0.047^{***}	0.018^{***}
	(0.017)	(0.008)	(0.004)
Fund fixed effect	X	X	X
Time fixed effect	X	X	X
R^2	0.763	0.821	0.91
Observations	4,402	4,402	4,402

Table 7: **Regression of portfolio share in debt type on Treasury futures share.** The table shows results of quartely regressions of intermediate investment-grade debt fund holdings of fixed, floating and variable debt on Treasury futures notional amounts to total assets. Results use N-PORT data from December 2019 to September 2023. All regressions include fund and time fixed effects. * indicates significance at the 10% level, ** at the 5% level, and *** at the 1% level.

	<5 years	5-10 years	10-20 years	>20 years
		All securities		
Treasury futures to assets	-0.022^{*}	-0.004	-0.008	0.012
	(0.013)	(0.01)	(0.006)	(0.014)
Fund fixed effect	X	X	X	X
Time fixed effect	X	X	X	X
R^2	0.8	0.784	0.797	0.842
Observations	4,402	4,402	4,402	4,402
		U.S. Treasuries only		
Treasury futures to assets	-0.064^{***}	-0.028^{***}	-0.008^{***}	-0.024^{***}
	(0.011)	(0.009)	(0.003)	(0.004)
Fund fixed effect	X	X	X	X
Time fixed effect	X	X	X	X
R^2	0.773	0.715	0.71	0.725
Observations	4,402	4,402	4,402	4,402

Table 8: **Regression of portfolio share in debt maturity on Treasury futures share.** The table shows results of quartely regressions of intermediate investment-grade debt fund holdings by years to maturity on Treasury futures notional amounts to total assets. Results use N-PORT data from December 2019 to September 2023. All regressions include fund and time fixed effects. * indicates significance at the 10% level, ** at the 5% level, and *** at the 1% level.

	Treasuries	MBS	Corporate Debt	Other ABS	Equty
Treasury futures to assets	-0.053^{***}	0.004^{***}	-0.005^{***}	0.004^{***}	0.028^{***}
	(0.007)	(0.003)	(0.002)	(0.002)	(0.008)
Fund fixed effect	X	X	X	X	X
Time $\times$ objective fixed effect	X	X	X	X	X
R^2	0.93	0.956	0.982	0.931	0.976
Observations	183,594	183,594	183,594	183,594	183,594

Table 9: **Regression of portfolio share in cash assets on Treasury futures share (all funds).** The table shows results of quartely regressions of holdings of particular asset classes on Treasury futures notional amounts to total assets. Results use N-PORT data from December 2019 to September 2023. All regressions include fund and time by Lipper objective fixed effects. * indicates significance at the 10% level, ** at the 5% level, and *** at the 1% level.

	Average duration	Difference from index	Standard error	Average absolute tracking error	Share within 1-year of index
			Full sample		
No futures	4.51	−0.64	0.009	13.06	87.27
Low futures	4.72	−0.43	0.014	8.48	95.24
Medium futures	4.77	−0.38	0.013	10.8	90.91
High futures	4.86	−0.29	0.01	7.18	95.65
High minus no	0.35***	0.35***			8.38
			2019		
No futures	4.13	−0.56	0.016	15.26	81.82
Low futures	4.28	−0.4	0.028	12.36	85.71
Medium futures	4.42	−0.27	0.023	14.32	87.88
High futures	4.5	−0.18	0.019	7.08	93.48
High minus no	0.37***	0.37***			11.66*
			2021		
No futures	4.17	−0.78	0.02	17.13	74.55
Low futures	4.57	−0.38	0.029	9.65	80.95
Medium futures	4.47	−0.48	0.024	11.72	87.88
High futures	4.5	−0.45	0.019	12.47	80.43
High minus no	0.34***	0.34***			5.89
			2023		
No futures	5.37	−0.59	0.019	10.83	83.64
Low futures	5.65	−0.32	0.032	6.79	90.48
Medium futures	5.72	−0.24	0.026	6.19	100.0
High futures	5.93	−0.04	0.022	5.43	97.83
High minus no	0.56***	0.56***			14.19**

Table 10: **Empirical durations of intermediate investment-grade debt funds by futures use.** The table shows details of the distribution of empirical durations of intermediate investment-grade debt funds split into subsamples by futures use and by year. For each sub-sample, average duration reports the average estimated empirical duration, estimated by regression daily returns within the subsample on the change in 10-year Treasury yields. Difference from index is the difference between this average and the Bloomberg Aggregate Index. Standard error is the standard error of the average, taking into account the underlying estimation error from the regression. Average absolute tracking error is the average across funds of the absolute percentage difference between the estimated duration of the fund and the index. Share within 1-year of the index is the share of funds with duration within 1-year of the index. The "high minus no" rows show the difference between high futures users and funds that do not use futures. Stars denote the significance of this difference, with * denoting significance at the 10% level, ** denoting significance at the 5% level, and *** at the 1% level.

	Dec 2019		Jun 2021		Jun 2023	
	Share	Duration	Share	Duration	Share	Duration
			Index funds			
U.S. Treasuries	42.99	6.4	41.51	6.79	45.07	6.04
Agency MBS	24.98	3.33	22.83	3.85	22.71	5.17
Private-label MBS	0.31	1.27	1.2	5.03	0.93	3.87
Corporate debt	22.21	8.23	24.61	9.02	22.39	7.4
CDO	0.04	0.42	0.32	1.57	0.43	2.01
Other ABS	0.05	0.13	0.01	0.06	0.01	0.04
Other	9.42	6.39	9.53	6.68	8.46	5.64
Total duration						
Cash only		6.03		6.62		6.08
Cash + Futures		6.03		6.62		6.08
			2023 Non-futures holders			
U.S. Treasuries	19.25	8.71	18.08	8.18	23.63	9.19
Agency MBS	32.58	3.38	27.04	4.3	33.17	4.24
Private-label MBS	6.45	2.4	4.65	3.22	3.15	2.4
Corporate debt	22.76	6.64	28.44	7.86	23.09	6.94
CDO	0.68	0.09	1.46	0.14	0.87	0.29
Other ABS	6.92	1.67	5.85	2.18	8.93	2.04
Other	11.36	6.51	14.48	7.02	7.16	6.26
Total duration						
Cash only		5.35		6.05		5.83
Cash + Futures		5.50		6.17		5.83
			2023 Futures holders			
U.S. Treasuries	21.62	9.3	29.71	9.41	21.52	9.3
Agency MBS	30.93	3.53	19.7	4.25	33.12	3.78
Private-label MBS	8.15	2.5	6.75	2.78	6.63	2.76
Corporate debt	21.76	5.56	25.24	7.38	22.81	5.95
CDO	2.21	0.78	1.85	0.83	1.68	1.01
Other ABS	2.28	1.7	2.83	2.04	3.24	1.86
Other	13.06	4.77	13.93	5.66	11.0	4.73
Total duration						
Cash only		5.06		6.28		5.28
Cash + Futures		6.11		6.76		6.08

Table 11: **Weighted average duration of intermediate investment-grade debt funds by investment.** This table shows the duration of cash holdings of intermediate investment-grade debt funds by asset category, along with the weight of each category in total net assets of the funds, and the total weighted-average duration of the funds. Results are split by index funds, non-futures holders and futures holders.

	Δ **Treasury futures duration**		
	(1)	(2)	(3)
Δ Cash duration	-0.360^{***}	-0.358^{***}	-0.417^{***}
	(0.059)	(0.059)	(0.065)
Fund fixed effect		X	X
Time fixed effect			X
R^2	0.070	0.100	0.149
Observations	1,051	1,051	1,051

Table 12: **Regression of change in Treasury futures duration on change in cash duration.** The table shows results of quartely regressions of changes in the duration of a fund's Treasury futures position against the duration of the cash portfolio. Results use N-PORT data from December 2019 to September 2023. * indicates significance at the 10% level, ** at the 5% level, and *** at the 1% level.

	Levels			Differences	
	Dec 2019	Jun 2021	Jun 2023	2021 – 2019	2023 – 2021
			Index funds		
Total duration	6.03	6.62	6.08	0.59	-0.54
2021 allocations	6.07	6.62	6.10	0.55	-0.52
2021 durations	6.54	6.62	6.57	0.08	-0.05
Agency MBS only	6.56	6.62	6.61	0.06	-0.01
			2023 Non-futures holders		
Total duration	5.35	6.05	5.83	0.70	-0.22
2021 allocations	5.61	6.05	6.02	0.44	-0.03
2021 durations	5.74	6.05	5.95	0.31	-0.10
Agency MBS only	5.52	6.05	5.69	0.53	-0.36
			2023 Futures holders		
Total duration	5.06	6.28	5.28	1.22	-1.00
2021 allocations	5.55	6.28	5.81	0.73	-0.47
2021 durations	5.76	6.28	5.98	0.52	-0.30
Agency MBS only	5.25	6.28	5.38	1.03	-0.90

Table 13: **Decomposition of changes in weighted average cash duration of intermediate investment-grade debt funds.** This table shows a decomposition of the changes in weighted average duration for the cash investments of intermediate investment-grade debt funds. The first three columns show the level of duration under different alternatives. In the row labelled "2021 allocations", weights on asset classes are held fixed at levels in June of 2021, but durations within the classes vary through time. In the "2021 durations" rows, durations within the classes are held fixed, but weights are allowed to vary. In the "Agency MBS only" row, we only allow the investment in agency MBS to vary, and assume that an additional dollar invested in agency MBS comes from a decrease of a dollar in investment into U.S. Treasuries.

	Treasury	Agency MBS	Private-label MBS	Corporate Debt	CDO	Other ABS
Treasury futures to assets	-0.186^{**} (0.092)	-0.179^{**} (0.072)	-0.112^{***} (0.028)	0.059^{***} (0.021)	-0.078^{***} (0.027)	0.002 (0.037)
Fund fixed effect	X	X	X	X	X	X
Time fixed effect	X	X	X	X	X	X
R^2	0.499	0.629	0.43	0.405	0.278	0.304
Observations	1,122	1,122	1,122	1,122	1,122	1,122

Table 14: **Regression of contribution of assets to changes in duration on Treasury futures share.** The table shows results of quartely regressions of the contribution to total changes in duration of different cash securities for intermediate investment-grade debt fund holdings on Treasury futures notional amounts to total assets. Results use N-PORT data from December 2019 to September 2023. The dependent variable in the first column is the actual duration, the second column is the duration that would result with 2021 allocations, the third column is the duration that would result with 2021 asset-level durations. All regressions include fund and time fixed effects. * indicates significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Table 15: Impact of MBS on Aggregate Asset Managers' Long Futures Positions

	Model I	Model II	Model III
MBS returns			
TBA OAS	23.14^{***}	12.62^{**}	
	(8.45)	(5.63)	
Dollar Roll Spec	-61.30	-28.07	
	(45.24)	(19.97)	
TBA OAS (MA)			13.39^{**}
			(5.58)
Dollar Roll Spec (MA)			-52.49^{**}
MBS sensitivities			
TBA Duration		-2.17^{***}	-2.10^{***}
		(0.59)	(0.57)
TBA Convexity		-3.37^{***}	-3.39^{***}
		(0.83)	(0.85)
			(23.86)
Controls			
Roll effect	-0.03^{***}	-0.03^{***}	-0.02^{***}
	(0.00)	(0.00)	(0.00)
Month indicators	X	X	X
R^2	0.33	0.79	0.80
Adj. R^2	0.31	0.78	0.79

$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$

Asset managers' long Treasury futures positions are normalized by total open interest. All RMBS covariates are for FNMA 30-year current coupon TBA trades and dollar rolls. Dynamics OLS estimates with $p = 2$. Newey-West robust standard errors with a lag of 52 weeks are reported in parenthesis. Data sources: J.P. Morgan Chase & Co.

	Return relative to Aggregate Index				Duration
	Average excess	Beta	Alpha	Std. Dev	component
No futures	0.28	0.88	0.32	0.45	0.37
Low futures	0.34	0.93	0.38	0.45	0.39
Medium futures	0.46	0.94	0.49	0.47	0.39
High futures	0.34	0.96	0.36	0.47	0.40

Table 16: **Performance of intermediate investment-grade debt funds by futures use.** The table shows statistics on the performance of IID funds grouped into no long Treasury futures use, and low medium and high Treasury futures use. Statistics include excess return relative to the aggregate index, the beta of the fund relative to the aggregate index, the alpha of the fund relative to the aggregate index, the standard deviation of the funds' return, and the component of that standard deviation due to duration according to a simple linear regression.

	Mentions derivatives...			
	in Principal Strategies		**in Principal Risks**	
	All funds	IID funds	All funds	IID funds
No futures	36%	47%	49%	57%
Low futures	85%	84%	85%	74%
Medium futures	78%	85%	83%	87%
High futures	79%	95%	83%	93%
χ^2	1069.82	65.2	726.04	51.4
p-value	1.3×10^{-231}	4.5×10^{-14}	4.7×10^{-157}	4.0×10^{-11}

Table 17: **Prospectus mentions of derivatives by notional futures holdiings.** The table shows share of all funds and intermediate investment-grade debt (IID) funds with mentions of derivatives in principal strategies and principal risks sections of the prospectus for funds with no holdings of Treasury futures in June 2023, low holdings (bottom-third of positive holdings), medium holdings (middle-third of positive futures holdings), and high holdings (upper-third of positive futures holdings). Statistics are for the latest prosectus avaiable prior to June 2023 for each fund.

	All futures users		**High futures users**	
Rank	Word	χ^2	Word	χ^2
1	mortgage	239.97	mortgage	134.67
2	backed	183.06	backed	95.42
3	debt	137.58	debt	65.4
4	duration	114.27	duration	54.3
5	fixed	104.15	dollar	53.26
6	swaps	97.73	swaps	44.92
7	credit	84.33	inflation	40.34
8	government	75.83	pgim	40.21
9	dollar	75.6	freedomincome	38.06
10	currency	71.69	credit	33.79
11	pimco	70.32	unrated	33.47
12	grade	68.64	rolls	33.13
13	tba	63.52	fixed	32.55
14	bonds	62.68	grade	32.4
15	default	61.62	linking	31.88
16	index	60.41	government	31.49
17	instruments	59.7	tba	30.39
18	derivatives	59.55	default	30.38
19	inflation	58.29	loan	29.79
20	rolls	56.7	guaranteed	29.57

Table 18: **Words in principal strategy section of prospectus most predictive of futures use.** The table shows the twenty words most predictive of futures use in 2023 across all funds according to the χ^2 statistic of their frequency within the principal strategy section of the funds' prospectuses. Statistics are for the latest prosectus avaiable prior to June 2023 for each fund. The left two columns show the words most predictive of any futures use, while the right two columns show the words most predictive of high futures use (upper-third positive futures holdings).

	Dependent variable: Has long Treasury futures			
		All funds		
	IID funds	(1)	(2)	(3)
Index Treasury share		25.50***		
		(5.926)		
Turnover ratio	0.063***	0.016***	0.008***	0.017***
	(3.143)	(3.822)	(2.675)	(4.425)
Risks mention leverage	0.200**	0.067***	0.065***	0.084***
	(2.277)	(8.637)	(8.554)	(8.359)
Strategy: Duration	−0.107	0.069***	0.015	0.013
	(−1.179)	(5.077)	(1.009)	(0.891)
Strategy: Mortgage	0.343*	0.221***	0.125***	0.123***
	(1.767)	(13.849)	(7.399)	(7.365)
Objective: Total return	−0.033	0.079***	0.051***	0.060***
	(−0.366)	(6.867)	(4.487)	(5.104)
Objective: Income	−0.137	0.013	0.005	0.019
	(−1.558)	(1.33)	(0.453)	(1.524)
Index fund dummy		−0.102***	−0.094***	−0.134***
		(−9.454)	(−6.649)	(−7.371)
Log of total net assets	0.075***	0.023***	0.024***	0.010***
	(3.77)	(13.286)	(13.704)	(4.943)
Objective fixed effect			X	X
Advisor fixed effect				X
Observations	143	5,886	5,886	5,886
R-squared	0.232	0.254	0.337	0.488

Table 19: **Explanatory regressions for Treasury futures holdings (indicator).** The table shows regression results for cross-sectional regressions on IID funds and all fund types of whether the fund is a Treasury futures holder on dummies for whether the principal risk section mentions leverage, whether the principal strategies section mentions duration or mortgages, whether the objective section mentions total return, and whether the objective section mentions income. Data is for the cross-section of funds as of Q2 2023. * denotes significance at the 10% level, ** denotes significance at the 5% level, and *** at the 1% level.

	Dependent Variable: Has long Treasury futures					
	(1)	(2)	(3)	(4)	(5)	(6)
Flow Volatility pre-2018 (%, monthly)	-0.75	-0.44				
	(-0.49)	(-0.36)				
Flow 2020-2021 (%, monthly)			-0.89	-1.88		
			(-0.46)	(-1.17)		
Flow 2022 (%, monthly)					-0.46	-0.84
					(-0.25)	(-0.51)
Controls		X		X		X
Adjusted R^2	-0.01	0.17	-0.01	0.18	-0.01	0.16
N	128	128	138	138	142	142

Table 20: **Fund flows and futures use for intermediate investment-grade debt funds.** This table regresses an indicator for whether the fund holds Treasury futures in June 2023 on various measures of fund flows. Columns (1) and (2) include as the independent variable the standard deviation of monthly flows for flows occurring prior to January 2018. In columns (3) and (4), the independent variable is the average of monthly flows between January 2020 and December 2021. In columns (5) and (6), the independent variable is the average flows occurring in 2022. In each specification, flows are calculated as a percentage of net assets. Robust standard errors are calculated in each specification and t-statistics are reported in parenthesis. Controls include turnover ratio, an indicator for whether the "Risks" section of the prospectus mentions leverage, indicators for whether the "Strategy" section of the prospectus mentions "Duration" or "Mortgage", indicators for whether the "Objectives" section of the prospectus mentions "Income" or "Total Return", and the log of net assets. * denotes significance at the 1% level, ** denotes significance at the 5% level, and *** denotes significance at the 10% level.

	Dependent variable: Percent flows		
	(1)	(2)	(3)
Log of total net assets	0.002***	0.003	0.003
	(3.592)	(1.23)	(1.231)
Quarterly return	0.528***	0.454***	0.571***
	(3.453)	(2.949)	(2.979)
Quarterly return × Low futures	−0.007	−0.012	−0.006
	(−0.105)	(−0.178)	(−0.083)
Quarterly return × Medium futures	−0.105	−0.107	−0.107
	(−1.586)	(−1.606)	(−1.607)
Quarterly return × High futures	−0.093*	−0.091*	−0.099*
	(−1.891)	(−1.825)	(−1.944)
Sales restriction			0.001
			(0.828)
Open to investors			0.001
			(0.165)
Retail fund			−0.001
			(−0.614)
Quarterly return × Sales restriction			−0.168***
			(−2.971)
Quarterly return × Open to investors			−0.28**
			(−2.194)
Quarterly return × Retail fund			−0.061
			(−1.029)
Time fixed effects	X	X	X
Entity fixed effects		X	X
Observations	8,288	8,288	8,288
R-squared	0.019	0.019	0.019

Table 21: **Flow-performance regressions for intermediate investment-grade debt funds.** The table shows regression results for regressions of fund flows on quarterly returns interacted with low, medium and high holdings of futures as of 2023. t-statistics are in parentheses. Regressions are at a monthly frequency. The dependent variable is the percentage of net assets that flow into the fund. The sample is restricted to active intermediate investment-grade debt funds observed in all months using the Bloomberg Aggregate Index as benchmark. The first columns control for time fixed-effects but not fund fixed-effects, and we have excluded estimates for the dummy variables of futures-use categories for brevity. The second column includes both fund and tiime fixed-effects, and the third column includes additional controls for sales restirctions, whether the fund is open to investors, and whether the fund is a retail fund. Standard errors are clustered at the fund level. The sample period is from January 2015 to December 2020. * denotes significance at the 10% level, ** denotes significance at the 5% level, and *** at the 1% level.

	Has long Treasury futures	Has reverse repo	Average reverse repo	**Strategies mention** Leverage Leverage	Repo Repo	**Risks mention** Leverage Leverage	Repo Repo
			Intermediate investment-grade debt funds				
Treasury futures use							
No	0.00	1.25	0.01	61.25	16.25	17.50	10.00
Yes	100.00	1.47	0.20	80.88	16.18	11.03	11.76
Reverse repo use							
No	62.91	0.00	0.00	73.24	15.49	13.15	10.80
Yes	66.67	100.00	9.10	100.00	66.67	33.33	33.33
Overall	62.96	1.39	0.13	73.61	16.20	13.43	11.11
			All funds				
Treasury futures use							
No	0.00	0.22	0.09	42.18	4.89	12.79	1.87
Yes	100.00	3.46	0.33	76.92	14.23	18.15	8.77
Reverse repo use							
No	10.82	0.00	0.00	45.75	5.49	13.29	2.41
Yes	66.18	100.00	19.84	97.06	80.88	30.88	41.18
Overall	11.14	0.58	0.12	46.05	5.93	13.39	2.64

Table 22: **Treasury futures use and reverse-repo use.** The table shows share of intermediate investment-grade debt (IID) funds and all funds with mentions of reverse repo or levereage in the principal risk of strategies section of the prospectus as well as the share of funds with long Treasury futures holdings, the share with reverse repo borrowing and the average of reverse repo borrowing to assets for funds with and without long Treasury futures holdings and with or without reverse repo borrowing. Data is for June 2023. Statistics are for the latest prosectus avaiable prior to June 2023 for each fund.

Asset class	Index funds Dec 2019	Index funds Jun 2021	Index funds Jun 2023	Non-futures holders Dec 2019	Non-futures holders Jun 2021	Non-futures holders Jun 2023	Futures holders Dec 2019	Futures holders Jun 2021	Futures holders Jun 2023
	Percent of total assets								
Total Treasuries	42	40	43	24	22	21	22	28	23
On-the-run	1	1	0	1	3	2	2	5	3
1-3 Off-the-run	4	6	5	4	4	3	6	10	4
Deep off-the-run	37	34	39	20	18	18	15	18	18
Total agency MBS	25	22	22	24	18	22	34	19	32
TBA	2	2	1	2	5	2	11	10	12
All other	24	20	21	22	13	19	23	10	19
Dollar roll (est)	1	0	0	0	0	0	3	1	1

Table 23: **Holdings of intermediate investment grade debt funds by liquidity categories:** The table shows the share of Treasury and agency mortgage-backed securities in total assets of intermediate investment grade debt funds as classified by Lipper in December 2019, June 2021 and June 2023. Asset categories are further split into categories corresponding to liquidity. For Treasuries, we break out holdings into on-the-run Treasuries, first- through third-off-the run Treasuries and all "deep" off-the-run Treasuries that were issued prior to the third-off-the-run. For agency MBS, we divide the sample into to-be-announced (TBA) securites and all other holdings, as well as showing an estimate of dollar roll activity based on the minimum of short and long TBA holdings. The sample is split into index funds and active funds that hold long futures and those that do not.

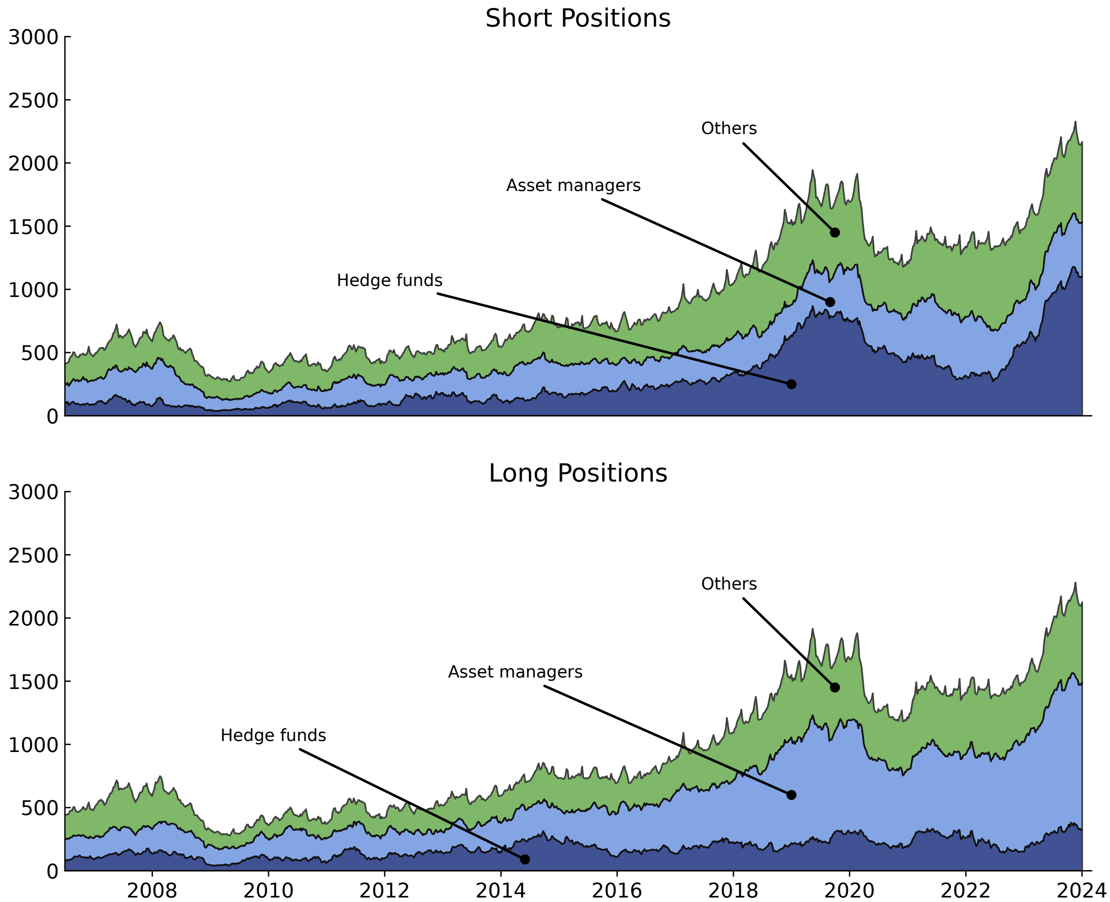

Figure 1: **Treasury futures positions by type of fund:** This figure shows notional billions of dollars in long and short Treasury futures positions for asset managers, hedge funds and other traders across all Treasury futures contracts. Data are from the CFTC's Commitment of Traders releases. This figure updates a similar figure shown in Barth and Kahn (2021).

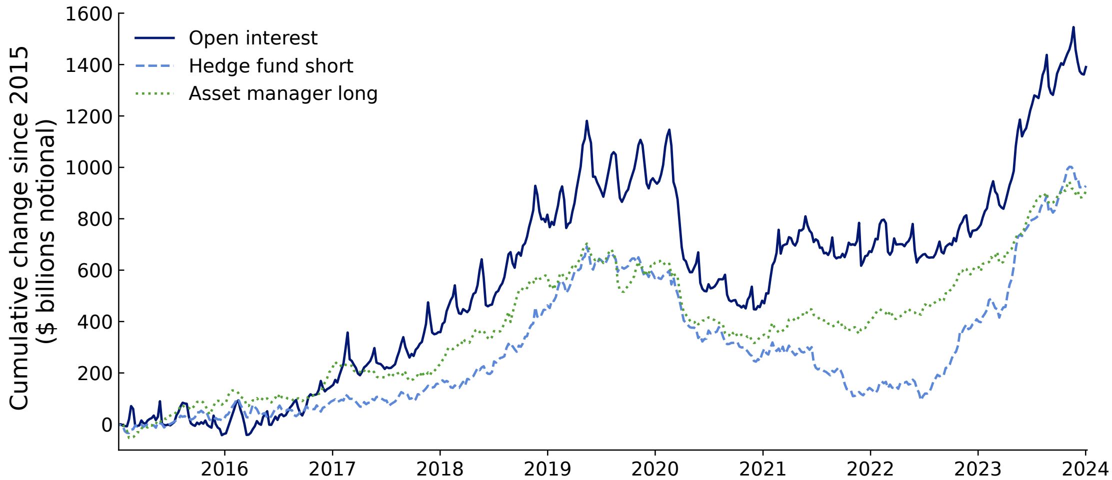

Figure 2: **Cumulative Changes in Treasury Futures:** This figure shows the cumulative change in aggregate long futures and aggregate long asset manager futures over time.

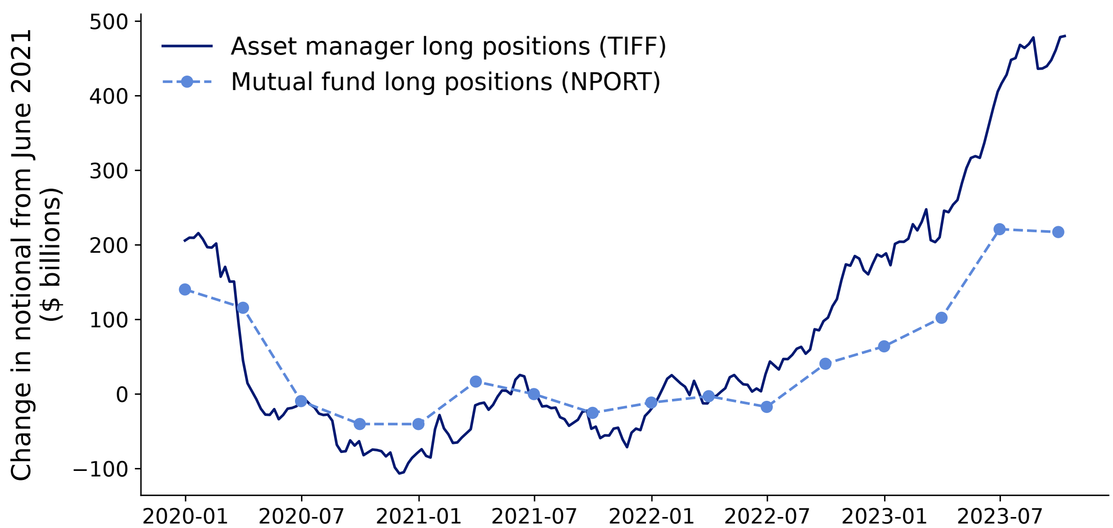

Figure 3: **Cumulative change in notional long Treasury futures positions of mutual funds and all asset managers:** The figure shows the cumulative change relative to June 2023 in notional long Treasury futures positions of mutual funds, taken from N-PORT data, and all asset managers, taken from Traders in Financial Futures data from the beginning of 2020 to 2023. The positions are in billions of total notional dollars.

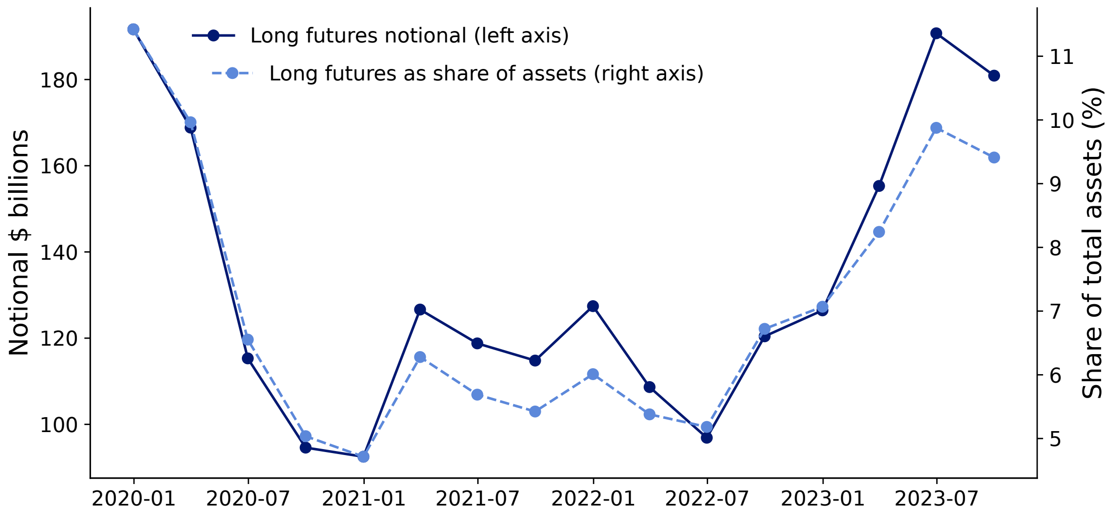

Figure 4: **Total long futures positions of IID mutual funds** The figure shows notional long positions in Treasury futures in $ billions and as a share of assets for intermediate investment-grade debt (IID) funds.

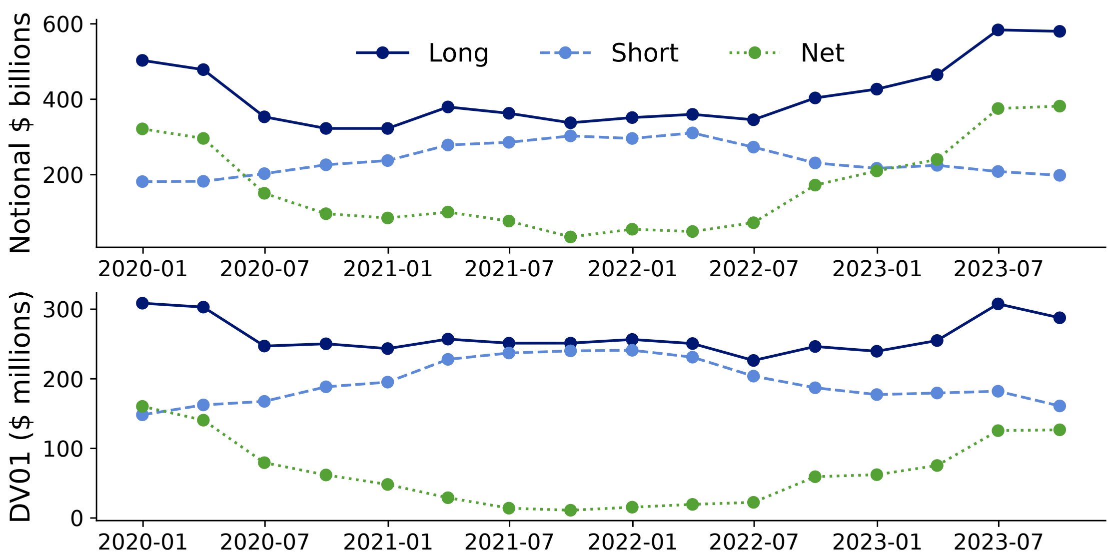

Figure 5: **Mutual fund goss and net positions in Treasury futures:** The figure shows total long, short and net Treasury futures positions of mutual funds in dollars (top panel) and DV01 (bottom panel).

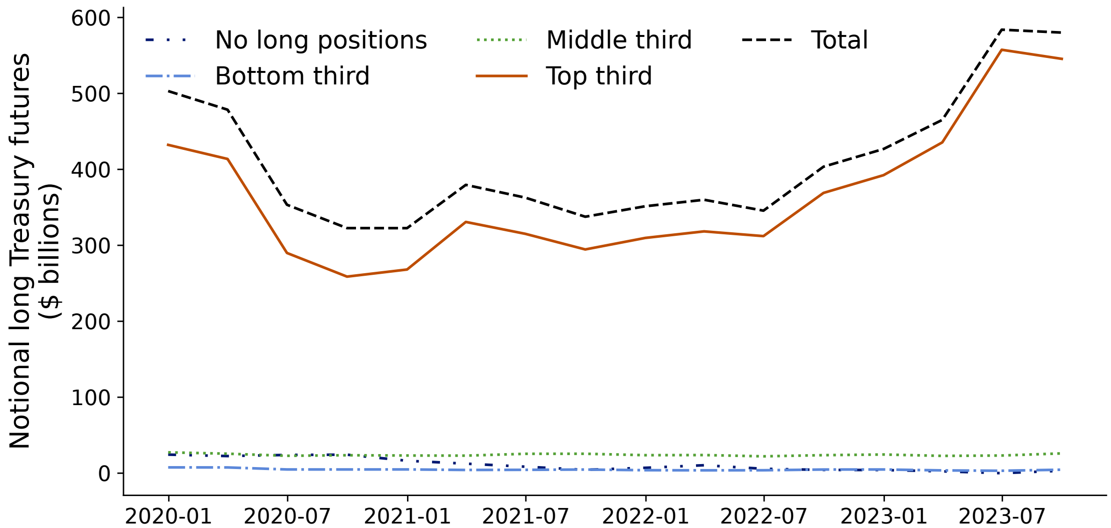

Figure 6: **Total long Treasury futures holdings over time by holdings as of June 2023:** The figure shows total holdings of futures by mutual funds for funds with different holdings as of June 2023, in particular split into no futures holdings in June 2023, and then the bottom, middle and top thirds of positive long futures holdings in June 2023.

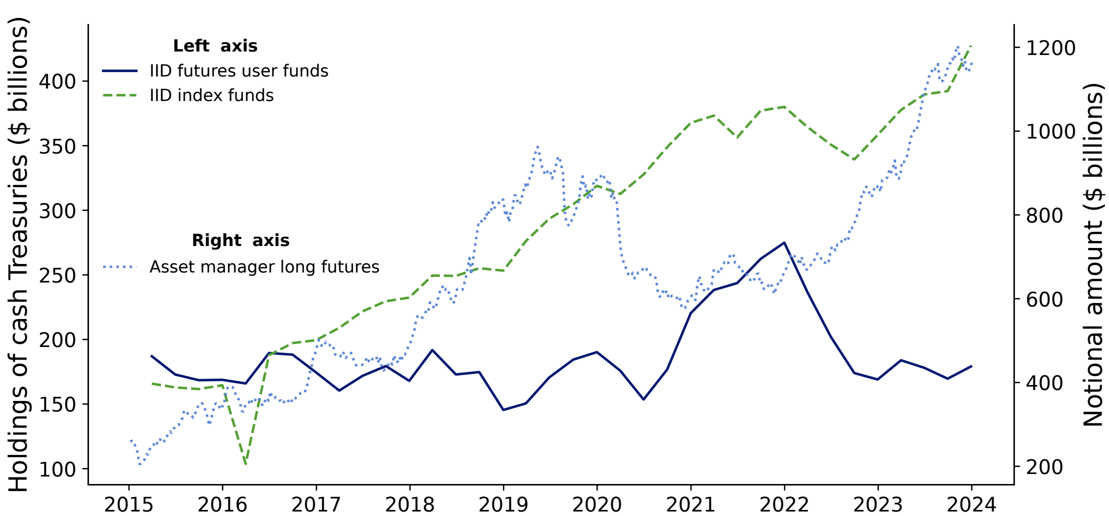

Figure 7: **Cash Treasury holdings of futures holder and non-futures holder intermediate investment grade debt funds:** The figure show total cash Treasury holdings of funds that held long Treasury futures in June 2023 and those that did not on the left axis. On the right axis, the figure shows total asset manager futures holdings from the CFTC's Traders in Financial Futures data.

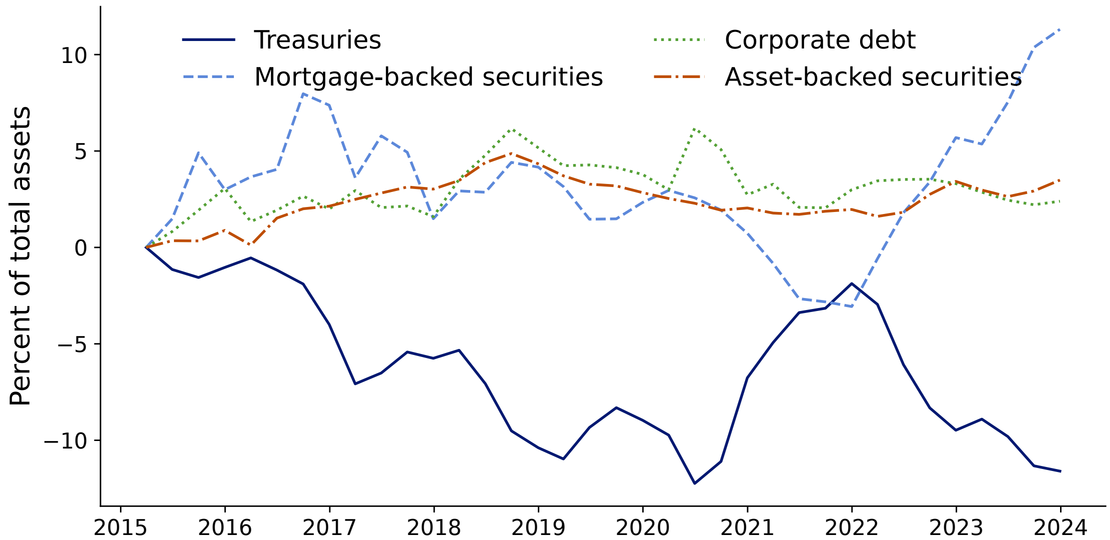

Figure 8: **Relative change in positions for futures holder and non-futures holder intermediate investment grade debt funds:** The figure shows the share of cash Treasuries and mortgage-backed securities in total assets since 2015 for futures holder and non-futures holder intermediate investment grade debt funds.

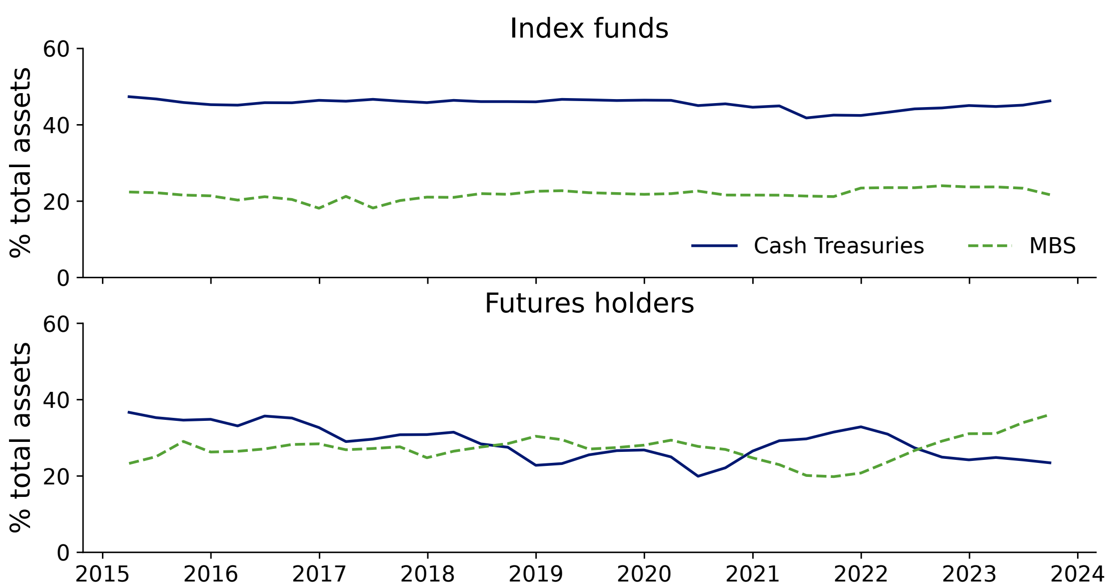

Figure 9: **Share of Treasury cash and mortgage backed securities in total assets for futures holder and index fund intermediate investment grade debt funds:** The figure show the difference between the cumulative change in share of different asset classes in total assets since 2015 for futures holders (bottom panel) and index funds (top panel) as of June 2023.

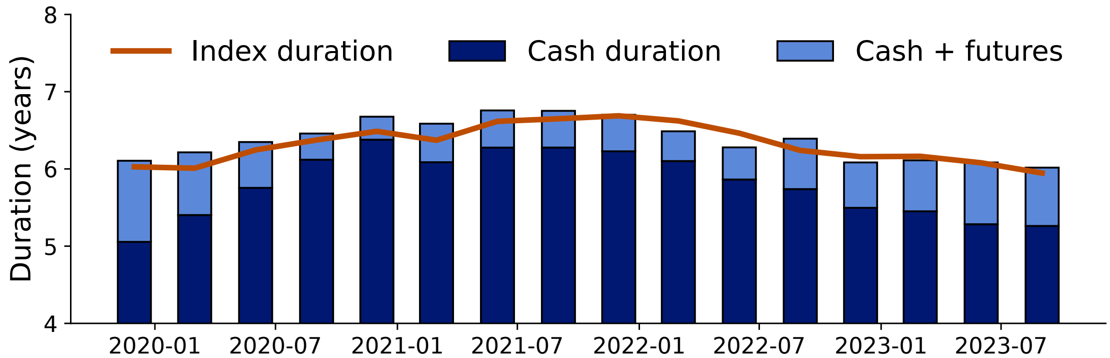

Figure 10: **Duration of cash and futures positions for intermediate investment-grade debt funds:** The figure show the difference between the cumulative change in share of different asset classes in total assets since 2015 for futures holders (bottom panel) and index funds (top panel) as of June 2023.

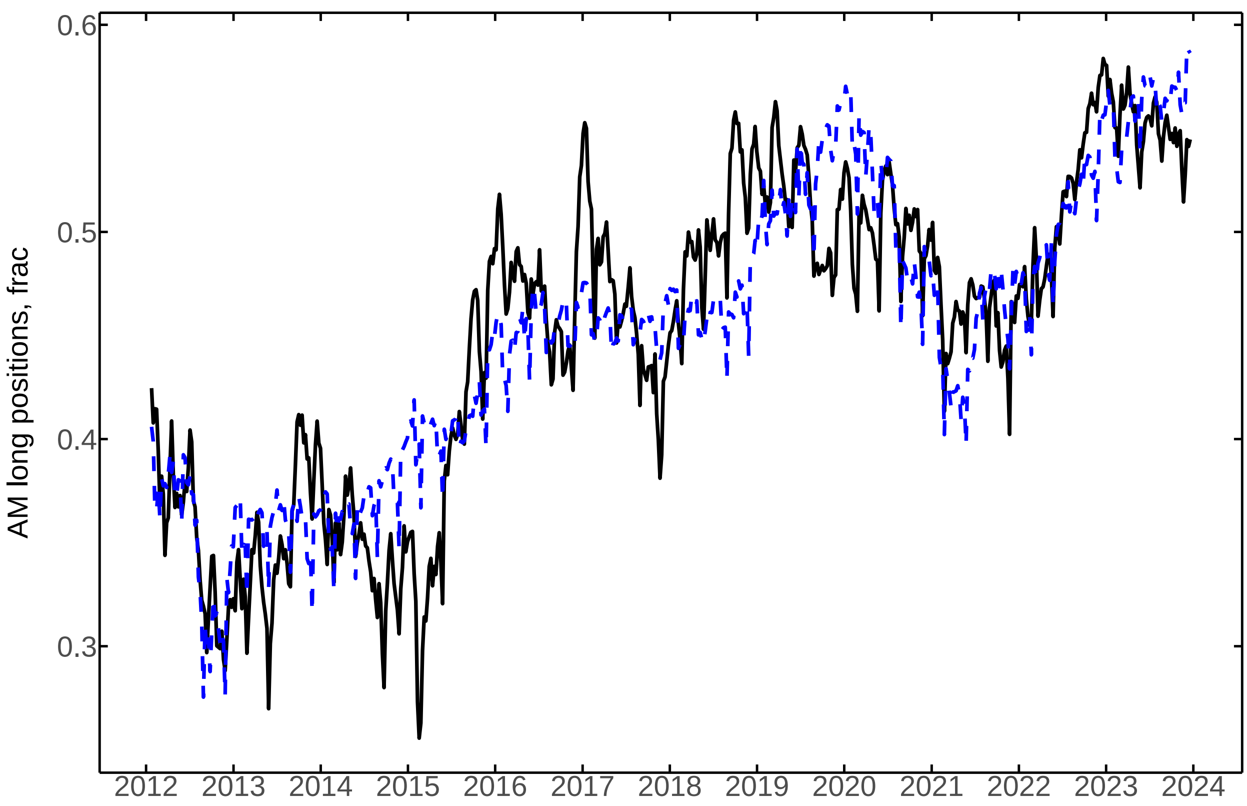

Figure 11: **Fraction of asset managers' aggregate long positions and model fit** The black line is the aggregate long Treasury futures positions of asset managers as a fraction of total long open interest, while the blue line is the fitted values from Model IV in Table 15.

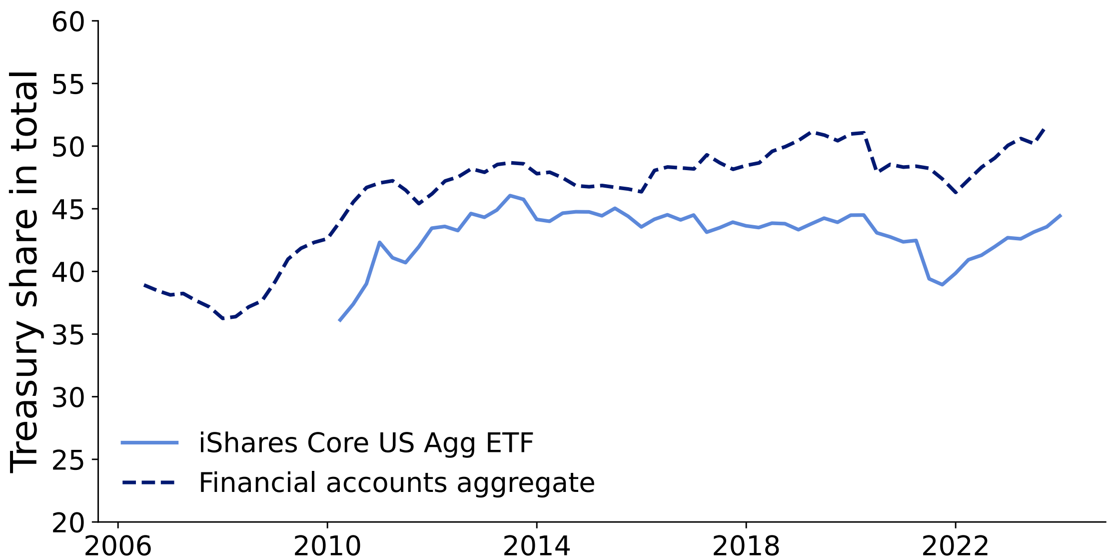

Figure 12: **Share of Treasuries in index fund and aggregate debt** The figure show the share of Treasuries in the iShares Core US Aggregate ETF and in aggregate debt as reported in the financial accounts aggregate and defined in the text of the paper. Series for the iShares Core US Aggregate ETF begin in 2010 with the beginning of portfolio share coverage from CRSP.

References

Alfaro, L., Bahaj, S., Czech, R., Hazell, J., and Neamțu, I. (2024). LASH risk and interest rates. Staff Working Paper 1073, Bank of England.

Anbil, S., Anderson, A. G., and Senyuz, Z. (2021). Are Repo Markets Fragile? Evidence from September 2019. *Finance and Economics Discussion Series*, 2021(026):1–58.

Baker, L., McPhail, L., and Tuckman, B. (2020). The liquidity hierarchy in the US treasury cash and futures market.

Banegas, A., Monin, P. J., and Petrasek, L. (2021). Sizing hedge funds' Treasury market activities and holdings. *FEDS Notes*, 2021(2979).

Barth, D. and Kahn, R. J. (2021). Hedge funds and the Treasury cash-futures disconnect. *Office of Financial Research Working Paper Series*, 21-01.

Barth, D., Kahn, R. J., and Mann, R. (2023). Recent Developments in Hedge Funds' Treasury Futures and Repo Positions: is the Basis Trade "Back"? *FEDS Notes*, (2023-08-30-2):None–None.

Becker, B. and Ivashina, V. (2015). Reaching for Yield in the Bond Market. *Journal of Finance*, 70(5):1863–1902.

Berk, J. and Green, R. (2004). Mutual fund flows and performance in rational markets. *Journal of Political Economy*, 112(6):1269–1295.

Burghardt, G. and Belton, T. (2005). *The Treasury Bond Basis: An in-Depth Analysis for Hedgers, Speculators, and Arbitrageurs*. McGraw-Hill Library of Investment and Finance. McGraw-Hill Education.

Cao, C., Ghysels, E., and Hatheway, F. (2011). Derivatives do affect mutual fund returns: Evidence from the financial crisis of 1998. *Journal of Futures Markets*, 31(7):629–658.

Chen, Q. and Choi, J. (2023). Reaching for Yield and the Cross Section of Bond Returns. *Management Science*.

Choi, J., Kim, M., and Randall, O. (2023). Hidden Duration: Interest Rate Derivatives in Fixed Income Funds.

Choi, J. and Kronlund, M. (2018). Reaching for yield in corporate bond mutual funds. *Review of Financial Studies*, 31(5):1930–1965.

Clark, K., Copeland, A., Kahn, R. J., Martin, A., McCormick, M., Riordan, W., and Wessel, T. (2021). How Competitive are U.S. Treasury Repo Markets? *Liberty Street Economics*.

Coval, J. and Stafford, E. (2007). Asset fire sales (and purchases) in equity markets. *Journal of Financial Economics*, 86(2):479–512.

Di Maggio, M. and Kacperczyk, M. (2017). The unintended consequences of the zero lower bound policy. *Journal of Financial Economics*, 123(1):59–80.

Dickey, D. A. and Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American statistical association*, 74(366a):427–431.

Du, W., Hébert, B., and Li, W. (2023). Intermediary balance sheets and the treasury yield curve. *Journal of Financial Economics*, 150(3):103722.

Duffie, D. (2020). Still the World's Safe Haven? *Hutchins Working Paper*, 62.

Eisenschmidt, J., Ma, Y., and Zhang, A. L. (2024). Monetary policy transmission in segmented markets. *Journal of Financial Economics*, 151:103738.

Fleckenstein, M. and Longstaff, F. A. (2020). Renting Balance Sheet Space: Intermediary Balance Sheet Rental Costs and the Valuation of Derivatives. *The Review of Financial Studies*, 33(11):5051–5091.

Fong, K., Gallagher, D. R., and Ng, A. (2005). The use of derivatives by investment managers and implications for portfolio performance and risk*. *International Review of Finance*, 5(1-2):1–29.

Garbade, K. D. (2021). *After the Accord*.

Ghysels, E., Santa-Clara, P., and Valkanov, R. (2004). The MIDAS touch: Mixed data sampling regression models.

Glicoes, J., Iorio, B., Monin, P. J., and Petrasek, L. (2024). Quantifying Treasury Cash-Futures Basis Trades. FEDS Notes 2024-03-08-3, Board of Governors of the Federal Reserve System (U.S.).

Han, S., Nikolaou, K., and Tase, M. (2022). Trading relationships in secured markets: evidence from triparty repos. *Journal of Banking and Finance*, 139.

Hayashi, F. (2011). *Econometrics*. Princeton University Press.

Hazelkorn, T. M., Moskowitz, T. J., and Vasudevan, K. (2023). Beyond basis basics: Liquidity demand and deviations from the law of one price. *The Journal of Finance*, 78(1):301–345.

He, Z., Nagel, S., and Song, Z. (2020). Treasury Inconvenience Yields during the COVID-19 Crisis. Technical report, National Bureau of Economic Research, Cambridge, MA.

J.P. Morgan Chase & Co (2023). MorganMarkets and DataQuery.

Kacperczyk, M. and Schnabl, P. (2013). How safe are money market funds? *Quarterly Journal of Economics*, 128(3).

Kahn, R. J. and Nguyen, V. (2022). Treasury Market Stress: Lessons from 1958 and Today. *OFR Briefs*.

Kahn, R. J., Nguyen, V., McCormick, M., Paddrik, M. E., and Young, H. P. (2023). Anatomy of the Repo Rate Spikes in September 2019. *Journal of Financial Crises*, 5:1–25.

Kahn, R. J. and Olson, L. (2021). Who Participates in Cleared Repo? *Briefs*.

Kandrac, J. (2018). The Cost of Quantitative Easing: Liquidity and Market Functioning Effects of Federal Reserve MBS Purchases. *International Journal of Central Banking*, 14(5):259–304.

Kaniel, R. and Wang, P. (2022). Unmasking Mutual Fund Derivative Use.

Koski, J. L. and Pontiff, J. (1999). How are derivatives used? evidence from the mutual fund industry. *The Journal of Finance*, 54(2):791–816.

Kruttli, M. S., Monin, P. J., Petrasek, L., and Watugala, S. W. (2021). Hedge Fund Treasury Trading and Funding Fragility: Evidence from the COVID-19 Crisis. *Finance and Economics Discussion Series*, 2021(037):1–68.

Menand, L. and Younger, J. (2023). Money and the Public Debt: Treasury Market Liquidity as a Legal Phenomenon. *Colum. Bus. L. Rev.*, 2023(1):224.

Phillips, P. C. B. and Ouliaris, S. (1990). Asymptotic properties of residual based tests for cointegration. *Econometrica: journal of the Econometric Society*, pages 165–193.

Pinter, G. (2023). An anatomy of the 2022 gilt market crisis. *SSRN Electronic Journal*.

Schrimpf, A., Shin, H. S., and Sushko, V. (2020). Leverage and margin spirals in fixed income markets during the Covid-19 crisis. BIS Bulletins 2, Bank for International Settlements.

Song, Z. and Zhu, H. (2019). Mortgage Dollar Roll. *The Review of Financial Studies*, 32(8):2955–2996.

Stock, J. H. and Watson, M. W. (1993). A simple estimator of cointegrating vectors in higher order integrated systems. *Econometrica: journal of the Econometric Society*, pages 783–820.

Vickery, J. I. and Wright, J. (2013). TBA trading and liquidity in the agency MBS market. *Economic Policy Review*, 19(1).

Vissing-Jorgensen, A. (2021). The Treasury Market in Spring 2020 and the Response of the Federal Reserve. *Journal of Monetary Economics*, 124(C):19–47.

A Appendix

A.1 Additional MBS Results and Robustness

A.1.1 Estimation Details

Option-adjusted duration, convexity and asset managers' long futures positions show considerable persistence — for these series, Augmented Dickey-Fuller tests (Dickey and Fuller (1979)) cannot reject the presence of unit roots at the 10 percent significance level. Thus, we first exclude the possibility of a spurious regression by verifying that the residuals from all models of specification (1) (where potentially integrated, $I(1)$, processes appear on both the left and right hand side of the equation) are not themselves integrated of order unity, as verified by the Augmented Dickey-Fuller unit root tests at the 5 percent significance level, using the cut-off values from Phillips and Ouliaris (1990). Our primary approach is to treat (1) as a cointegrating relationship and estimate it accordingly by dynamic OLS (DOLS).[18] For all estimated models, we report Newey-West robust standard errors with a lag of 52 weeks.[19] Finally, we note that in the case that none of the true data-generating processes are integrated of order unity, our parameter estimates and their standard deviations remain valid.[20]

A.1.2 Individual Futures Contracts

We examine individual futures contracts. We consider the Model IV version of specification (1) for asset managers' long Treasury futures positions in: (i) the 2-year contract (Model TU); (ii) the 5-year contract (Model FV), (iii) the 10-year contract (Model TY); (iv) the average of the 10-year Ultra, 30-year, and 30-year Ultra contracts (Model Long Dur); and (iv) the average of 2-year and 10-year contracts (Model TY-TY). All long positions are normalized by the total open interest over all Treasury futures contracts. Table A.7 reports DOLS estimates of these models and the associated Newey-West standard errors.

Asset managers' long positions in the 2-year contract (Model TU) exhibit the qualitative responses that we identified for aggregate holdings and, in particular, present the strongest support

[18] See Stock and Watson (1993), as well as Hayashi (2011) and references therein.

[19] As a further robustness check (not reported), we conducted block bootstraps to further verify the significance of our results with less reliance on the asymptotic distribution of coefficient estimates.

[20] We obtain qualitatively similar results when estimating models with OLS, instead of DOLS.

for the duration hedging motive of holding Treasury futures. Also, longer duration futures (Model Long Dur) exhibit negative and significant, albeit less pronounced, dependence on RMBS duration. Notably, Model FV suggests that the 5-year contract may be more actively used for convexity rather than for duration hedging. The RMBS covariates explain more variation for the 2-year and longer duration futures relative to the 5-year and, especially, 10-year contracts. Interestingly, the average of 10-year Ultra, 30-year, and 30-year Ultra Treasury futures long positions is negatively affected by RMBS return proxies.

A.1.3 Robustness to GSE pool selection

In this section, we establish robustness of our results with respect to the type of generic GSE pools underlying the TBAs. Table A.8 reports the parameter estimates of model specification (1) for aggregate asset managers' long futures positions and GNMA 30-year current coupon covariates.

Table A.9 reports estimates for the effects of RMBS variables on asset managers' long futures positions broken out by contract. Once again, the role of 5-year futures as convexity hedges clearly stands out.

A.2 Alternative model specification for MBS effects

Instead of relying on Newey-West standard errors, we may also consider a specification with an autoregressive component:

$$\omega_t = \alpha_0 + \alpha_1 \omega_{t-1} + \mathbf{X}_t \beta + \mathbf{roll.eff}_t + \sum_{i=2}^{12} \gamma_i \mathbf{Month}_t^i + \epsilon_t \tag{2}$$

	Dec 2019	Jun 2021	Jun 2023	Dec 2019 to Jun 2021	Jun 2021 to Jun 2023
			Total		
All asset managers	410	493	439	83	-54
Mutual funds	181	285	208	104	-77
			2-year		
All asset managers	176	104	101	-72	-3
Mutual funds	46	61	29	15	-32
			5-year		
All asset managers	83	111	93	28	-18
Mutual funds	39	46	31	7	-15
			10-year		
All asset managers	81	152	123	71	-29
Mutual funds	40	83	59	43	-24
			10-year Ultra		
All asset managers	29	66	65	37	-1
Mutual funds	26	50	47	24	-3
			30-year		
All asset managers	28	30	29	2	-1
Mutual funds	21	19	17	-2	-2
			30-year Ultra		
All asset managers	10	28	27	18	-1
Mutual funds	8	24	22	16	-2

Table A.1: **Notional short Treasury futures of all asset managers and mutual funds:** The table shows the notional amount of Treasury futures held by all asset managers (from the CFTC's Traders in Financial Futures data) and mutual funds (from Form N-PORT) at the end of December 2019, June 2021, and June 2023. The last two columns show the change in notional amount from December 2019 to June 2021 and from June 2021 to June 2023.

	MBS			ABS	
	Agency	Private-label	Roll (est)	CDO	Other
Treasury futures to assets	0.030**	0.017***	0.007**	0.030***	0.010**
	(0.014)	(0.005)	(0.003)	(0.006)	(0.004)
Fund fixed effect	X	X	X	X	X
Time fixed effect	X	X	X	X	X
R^2	0.839	0.915	0.481	0.838	0.915
Observations	4,402	4,402	4,402	4,402	4,402

Table A.2: **Regression of detailed ABS shares on Treasury futures share.** The table shows results of quartely regressions of intermediate investment-grade debt fund holdings of particular asset classes on Treasury futures notional amounts to total assets. Results use N-PORT data from December 2019 to September 2023. Roll indicates estimated mortgage dollar roll activity. All regressions include fund and time fixed effects. * indicates significance at the 10% level, ** at the 5% level, and *** at the 1% level.

	Credit quality		Borrower domicile	
	Investment-grade	Speculative-grade	U.S.	Non-U.S.
Treasury futures to assets	0.026***	−0.016***	−0.010	0.018***
	(0.008)	(0.004)	(0.007)	(0.003)
Fund fixed effect	X	X	X	X
Time fixed effect	X	X	X	X
R^2	0.839	0.862	0.863	0.897
Observations	4,402	4,402	4,402	4,402

Table A.3: **Regression of detailed corporate debt shares on Treasury futures share.** The table shows results of quartely regressions of intermediate investment-grade debt fund holdings of particular asset classes on Treasury futures notional amounts to total assets. Results use N-PORT data from December 2019 to September 2023. All regressions include fund and time fixed effects. * indicates significance at the 10% level, ** at the 5% level, and *** at the 1% level.

	Cash security duration		
	Actual	2021 allocations	2021 durations
Treasury futures to assets	-0.487^{***}	0.282	-0.519^{***}
	(0.165)	(0.231)	(0.14)
Fund fixed effect	X	X	X
Time fixed effect	X	X	X
R^2	0.8	0.771	0.89
Observations	1,122	1,122	1,122

Table A.4: **Regression of portfolio duration on Treasury futures share.** The table shows results of quartely regressions of the duration of cash securities for intermediate investment-grade debt fund holdings on Treasury futures notional amounts to total assets. Results use N-PORT data from December 2019 to September 2023. The dependent variable in the first column is the actual duration, the second column is the duration that would result with 2021 allocations, the third column is the duration that would result with 2021 asset-level durations. All regressions include fund and time fixed effects. * indicates significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Rank	All futures users		High futures users	
	Word	χ^2	Word	χ^2
1	backed	220.63	backed	95.75
2	mortgage	186.31	mortgage	89.45
3	debt	97.58	libor	42.8
4	libor	92.11	chance	39.66
5	loans	82.71	debt	36.59
6	credit	78.88	moderate	33.98
7	loan	62.13	loans	33.34
8	rate	58.31	credit	29.39
9	derivatives	56.07	loan	27.29
10	prepayment	50.46	mortgages	23.81
11	mortgages	47.82	rolls	21.43
12	rates	47.51	rate	21.09
13	companies	46.35	derivatives	19.56
14	quality	39.57	rates	18.87
15	pimco	39.11	refinance	17.91
16	sovereign	39.04	companies	16.97
17	extension	38.22	extension	16.72
18	obligations	38.05	prepayment	16.45
19	chance	37.47	tba	15.32
20	fixed	36.57	index	15.12

Table A.5: **Words in principal risks section of prospectus most predictive of futures use.** The table shows the twenty words most predictive of futures use in 2023 across all funds according to the χ^2 statistic of their frequency within the principal risks section of the funds' prospectuses. Statistics are for the latest prosectus avaiable prior to June 2023 for each fund. The left two columns show the words most predictive of any futures use, while the right two columns show the words most predictive of high futures use (upper-third positive futures holdings).

	Dependent variable: Long Treasury futures to assets			
		All funds		
	IID funds	(1)	(2)	(3)
Index Treasury share		8.099***		
		(5.809)		
Turnover ratio	0.016**	0.003***	0.002**	0.004***
	(2.456)	(3.301)	(2.363)	(2.811)
Risks mention leverage	0.043	0.013***	0.015***	0.017***
	(1.186)	(7.235)	(7.898)	(6.439)
Strategy: Duration	−0.058	0.016***	0.005	0.001
	(−1.211)	(4.231)	(1.139)	(0.163)
Strategy: Mortgage	0.166***	0.046***	0.023***	0.022***
	(3.654)	(9.924)	(5.548)	(4.508)
Objective: Total return	−0.025	0.010***	0.007**	0.007**
	(−1.047)	(3.191)	(2.161)	(1.976)
Objective: Income	−0.079**	−0.007**	−0.010***	−0.008*
	(−2.083)	(−2.534)	(−2.628)	(−1.934)
Index fund dummy		−0.018***	−0.017***	−0.018***
		(−7.58)	(−6.001)	(−4.406)
Log of total net assets	0.029***	0.003***	0.003***	0.001
	(2.876)	(5.068)	(5.242)	(1.45)
Objective fixed effect			X	X
Advisor fixed effect				X
Observations	143	5,886	5,886	5,886
R-squared	0.232	0.254	0.337	0.488

Table A.6: **Explanatory regressions for Treasury futures holdings (percent of assets).** The table shows regression results for cross-sectional regressions on IID funds only and on all fund types of notional Treasury futures over total assets on dummies for whether the principal risk section mentions leverage, whether the principal strategies section mentions duration or mortgages, whether the objective section mentions total return, and whether the objective section mentions income. Data is for the cross-section of funds in Q2 2023. * denotes significance at the 10% level, ** denotes significance at the 5% level, and *** at the 1% level.

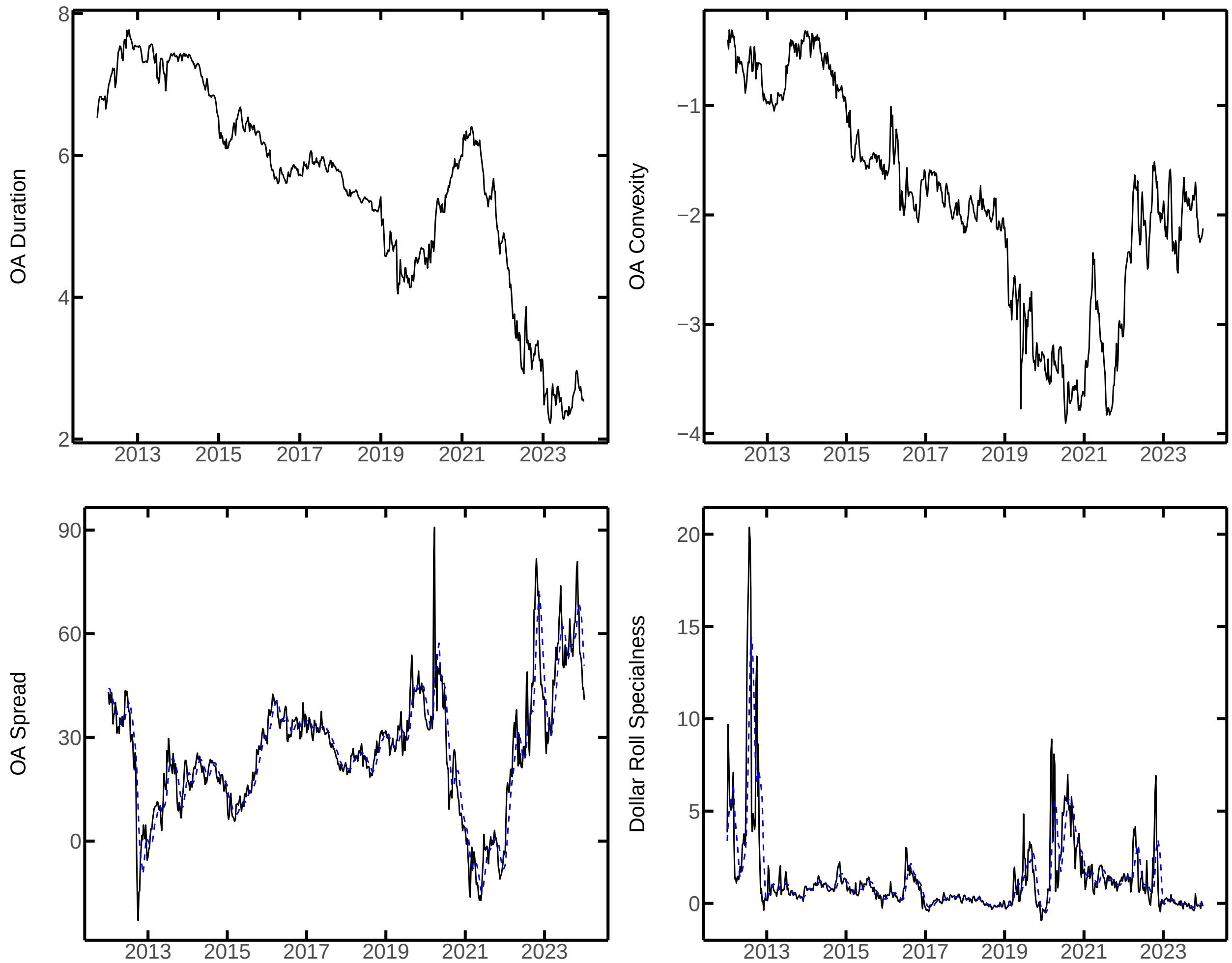

Figure A.13: **RMBS Rate Sensitivities and Return Proxies.** The blue lines in the bottom panels are 8-weeks moving averages of the corresponding time series. Data source: J.P. Morgan Chase & Co.

	Model TU	Model FV	Model TY	Model Long Dur	Model TU-TY
MBS sensitivities					
TBA Duration	-1.01^{***}	0.75	-0.22	-0.54^{***}	-0.61^{***}
	(0.38)	(0.70)	(0.23)	(0.09)	(0.17)
TBA Convexity	-2.40^{***}	-1.90^{**}	0.52	0.13	-0.94^{***}
	(0.54)	(0.76)	(0.36)	(0.13)	(0.16)
MBS returns					
TBA OAS (MA)	6.78^{*}	9.78^{*}	2.51	-1.89^{***}	4.64^{***}
	(3.74)	(5.60)	(2.12)	(0.68)	(1.50)
Dollar Roll Spec (MA)	12.61	-106.11^{***}	-14.26	18.43^{***}	-0.83
	(18.96)	(26.13)	(10.71)	(3.85)	(9.30)
Controls					
Roll effect	-0.00	-0.01^{***}	-0.01^{***}	-0.00^{**}	-0.00^{*}
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Month indicators	X	X	X	X	X
R^2	0.72	0.43	0.24	0.60	0.75
Adj. R^2	0.71	0.40	0.20	0.58	0.74

$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$

Table A.7: **Impact of MBS on Asset Managers' Long Futures Positions by Contract.** Asset managers' long Treasury futures positions are normalized by total open interest. All RMBS covariates are for FNMA 30-year current coupon TBA trades and dollar rolls. Dynamics OLS estimates with $p = 2$. Newey-West robust standard errors with a lag of 52 weeks are reported in parenthesis. Data sources: J.P. Morgan Chase & Co.

	Model I	Model II	Model III	Model IV
MBS sensitivities				
TBA Duration	-5.82^{***}		-4.22^{***}	-4.24^{***}
	(0.74)		(0.86)	(0.99)
TBA Convexity	0.63		-2.75^{**}	-2.74^{**}
	(1.49)		(1.12)	(1.20)
MBS returns				
TBA OAS		10.82^{***}	7.67^{***}	
		(2.28)	(2.20)	
Dollar Roll Spec		-58.36	38.41^{**}	
		(40.77)	(18.25)	
TBA OAS (MA)				7.86^{***}
				(2.42)
Dollar Roll Spec (MA)				37.15
				(23.89)
Controls				
Roll effect	-0.02^{***}	-0.03^{***}	-0.02^{***}	-0.02^{***}
	(0.01)	(0.01)	(0.00)	(0.00)
R^2	0.73	0.41	0.80	0.81
Adj. R^2	0.71	0.39	0.79	0.79
Month indicators	X	X	X	X

$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$

Table A.8: **Impact of MBS on Aggregate Asset Managers' Long Futures Positions: GNMA 30-year CC covariates** Asset managers' long Treasury futures positions are normalized by total open interest. All RMBS covariates are for GNMA 30-year current coupon TBA trades and dollar rolls. Dynamics OLS estimates with $p = 2$. Newey-West robust standard errors with a lag of 52 weeks are reported in parenthesis. Data sources: J.P. Morgan Chase & Co.

	Model TU	Model FV	Model TY	Model Long Dur	Model TU-TY
MBS sensitivities					
TBA Duration	-3.55^{***}	0.29	0.57	-0.52^{**}	-1.49^{***}
	(1.14)	(0.82)	(0.66)	(0.25)	(0.54)
TBA Convexity	0.32	-4.22^{***}	-0.76	0.64^{**}	-0.22
	(1.26)	(1.24)	(0.73)	(0.32)	(0.60)
MBS returns					
TBA OAS (MA)	2.00	3.06^{*}	2.27^{**}	0.18	2.13^{*}
	(2.03)	(1.74)	(1.02)	(0.52)	(1.09)
Dollar Roll Spec (MA)	79.87^{***}	-51.84^{***}	-28.19	12.44^{**}	25.84^{***}
	(29.22)	(16.34)	(17.40)	(5.28)	(9.35)
Controls					
Roll effect	0.00	-0.01^{***}	-0.01^{***}	-0.00^{**}	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Month indicators	X	X	X	X	X
R^2	0.60	0.66	0.21	0.49	0.69
Adj. R^2	0.58	0.64	0.17	0.46	0.67

$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$

Table A.9: **Impact of MBS on Asset Managers' Long Futures Positions by Contract: GNMA 30-year CC covariates** Asset managers' long Treasury futures positions are normalized by total open interest. All RMBS covariates are for GNMA 30-year current coupon TBA trades and dollar rolls. Dynamics OLS estimates with $p = 2$. Newey-West robust standard errors with a lag of 52 weeks are reported in parenthesis. Data sources: J.P. Morgan Chase & Co.

Table A.10: Impact of MBS on Aggregate Asset Managers' Long Futures Positions: specification with an AR term

	Model I	Model II	Model III	Model IV
MBS sensitivities				
TBA OAS		0.55^{**}	0.91^{**}	
		(0.25)	(0.41)	
Dollar Roll Spec		-4.64^{**}	-4.96^{**}	
		(2.11)	(2.03)	
MBS returns				
TBA OAS (MA)				1.04^{**}
				(0.43)
Dollar Roll Spec (MA)				-6.35^{**}
				(2.95)
TBA Duration	-0.27^{***}		-0.19^{***}	-0.19^{***}
	(0.06)		(0.07)	(0.07)
TBA Convexity	-0.14^{***}		-0.25^{***}	-0.27^{***}
	(0.04)		(0.07)	(0.07)
Controls				
lag AM long pos	0.93^{***}	0.97^{***}	0.92^{***}	0.92^{***}
	(0.01)	(0.01)	(0.01)	(0.02)
Roll effect	-0.01^{***}	-0.01^{***}	-0.01^{***}	-0.01^{***}
	(0.00)	(0.00)	(0.00)	(0.00)
Month indicators	X	X	X	X

$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$

Asset managers' long Treasury futures positions are normalized by total open interest. All RMBS covariates are for FNMA 30-year current coupon TBA trades and dollar rolls. Dynamics OLS estimates with $p = 2$. Newey-West robust standard errors with a lag of 52 weeks are reported in parenthesis. Data sources: J.P. Morgan Chase & Co.

Table A.11: **Impact of MBS on Aggregate Asset Managers' Long Futures Positions: specification with an AR term** Asset managers' long Treasury futures positions are normalized by total open interest. All RMBS covariates are for FNMA 30-year current coupon TBA trades and dollar rolls. Dynamics OLS estimates with $p = 2$. Newey-West robust standard errors with a lag of 52 weeks are reported in parenthesis. Data sources: J.P. Morgan Chase & Co.

	Strategies mention		Objectives mention		Average reported	
	Maturity bounds	Duration target	Total return	Current income	Turnover ratio	Expense ratio
No futures	25%	34%	54%	36%	1.14	0.0058
Low futures	28%	28%	71%	40%	2.05	0.0058
Medium futures	16%	38%	76%	28%	2.45	0.0059
High futures	18%	37%	67%	41%	2.64	0.0073
χ^2	2.29	0.99	7.64	1.88		
p-value	0.51	0.8	0.05	0.6		

Table A.12: **Prospectus mentions of key phrases by notional futures holdings.** The table shows share of intermediate investment-grade debt (IID) funds with mentions of maturity bounds or duration targets in principal strategies and of total returns or income in the objectives section of the prospectus, as well as average turnover and expense ratios, for funds with no holdings of Treasury futures in June 2023, low holdings (bottom-third of positive holdings), medium holdings (middle-third of positive futures holdings), and high holdings (upper-third of positive futures holdings). Statistics are for the latest prosectus avaiable prior to June 2023 for each fund.

	Has long Treasury futures	Has rate swaps	Average rate swaps	**Strategies mention** Leverage Leverage	Swaps Swaps	**Risks mention** Leverage Leverage	Swaps Swaps
			Intermediate investment-grade debt funds				
Treasury futures use							
No	0.00	8.75	4.22	61.25	30.00	17.50	43.75
Yes	100.00	41.18	110.36	80.88	44.12	11.03	82.35
Swap exposure							
No	52.29	0.00	0.00	69.28	30.72	12.42	58.82
Yes	88.89	100.00	243.61	84.13	58.73	15.87	90.48
Overall	62.96	29.17	71.05	73.61	38.89	13.43	68.06
				All funds			
Treasury futures use							
No	0.00	1.46	77.09	42.18	18.47	12.79	24.36
Yes	100.00	28.69	401.10	76.92	46.00	18.15	68.31
Swap exposure							
No	8.32	0.00	0.00	44.05	19.78	12.86	26.29
Yes	71.18	100.00	2,520.21	88.74	58.97	24.62	92.37
Overall	11.14	4.49	113.19	46.05	21.54	13.39	29.25

Table A.13: **Treasury futures use and interest-rate swap use.** The table shows share of intermediate investment-grade debt (IID) funds and all funds with mentions of swaps or levereage in the principal risk of strategies section of the prospectus as well as the share of funds with long Treasury futures holdings, the share with interest-rate swaps exposure and the average of interest-rate swap notional to assets for funds with and without long Treasury futures holdings and with or without interest-rate swap exposure. Data is for June 2023. Statistics are for the latest prosectus avaiable prior to June 2023 for each fund.