Private Money, Public Debt: Quarter-End Price Pressure in Treasury Bills*

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Abstract

This paper shows that quarter-end bank window dressing creates a substitution channel from private to public money-like assets. Around regulatory reporting dates, foreign banks reduce borrowing from U.S. money market funds; constrained to hold short-term, high-quality assets, the funds redeploy the displaced cash into Treasury bills. As a result, short-maturity U.S. Treasury yields fall by 3–9 basis points at quarter-ends. Using a network shift-share design that exploits predetermined fund-bank relationships and cross-sectional variation in Treasury bill holdings across funds, we causally estimate that money market fund demand inflows equal to 1 percent of Treasury bill market value lower yield spreads by 4.9 basis points. We use this estimate to quantify the fiscal consequences of bill-heavy debt issuance under alternative Treasury financing scenarios.

Keywords: Treasury bills; money market funds; bank regulation; window dressing; safe assets; market macrostructure.

JEL Codes: E43, E58, G12, G23, G28, H63.

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‡London School of Economics. Email: y.tian11@lse.ac.uk. Job market paper.

1 Introduction

The short-term Treasury market lies at the heart of the modern safe-asset ecosystem, serving as the benchmark risk-free market for cash management, collateralized funding, and monetary policy implementation. Despite its depth and liquidity, the market exhibits a striking and economically significant pricing regularity. At almost every calendar quarter-end, yields on short-maturity U.S. Treasury securities fall by 3–9 basis points, with the largest declines concentrated at maturities below three months. This pattern is surprising for two reasons. First, it occurs in one of the deepest and most liquid financial markets in the world, consisting of securities with negligible duration and essentially no credit risk. Second, the timing is perfectly predictable. Because quarter-ends are known well in advance, a recurring price movement of this magnitude should ordinarily invite arbitrage. Yet the effect persists.

The conventional explanation for quarter-end price anomalies emphasizes regulatory balance-sheet constraints[1]. Because many regulatory ratios are measured from balance-sheet snapshots, banks and dealers compress balance-sheet-intensive positions around reporting dates. The standard interpretation is therefore an intermediary-capacity and limits-to-arbitrage story: quarter-end prices move and spreads widen because dealer banks step back and arbitrageurs become constrained. This paper shows, through the lens of the short-term Treasury market, that this conventional view is incomplete. Quarter-end affects financial markets through two distinct channels: it reduces the supply of intermediary balance-sheet capacity and, more importantly, increases investors' demand for public safe assets. When banks reduce short-term borrowing from money market funds (MMFs), they shrink the supply of private money-like claims available to these investors. Constrained to hold short-term, high-quality, liquid assets, MMFs redeploy the displaced cash into short-term Treasuries, generating predictable demand pressure at the front end of the Treasury curve. Quarter-end price movements therefore reflect not only constrained intermediaries but also systematic shifts in the demand for public safe assets.

In this paper, we document the pricing pattern using daily security-level data on U.S.

[1] In repo markets (Munyan, 2017; Correa et al., 2020; Copeland et al., 2025), covered-interest-parity deviations (Du et al., 2018b), FX swap markets (Wallen, 2020; Kloks et al., 2024; Du et al., 2025), and the long-term Treasury futures market (Fleckenstein and Longstaff, 2020a).

Treasury securities from 2012 through 2024. Comparing the last trading day of each calendar quarter to other trading days, and controlling for security characteristics, monetary policy, auction, and issuance-type fixed effects, we find that quarter-end spreads are 3–9 basis points lower, with the effect declining monotonically across maturity buckets below one year. An event study traces the dynamics more precisely: yields begin declining roughly two weeks before the quarter-end date, reach their trough on the quarter-end day itself, and take another two weeks to fully recover, with the sharpest movement concentrated at the shortest maturities. The pattern is absent for Treasury notes and bonds with more than one year to maturity, pointing to the short-maturity investor base rather than a generic market-wide effect.

To understand the mechanism behind this pricing pattern, we develop a simple model. Banks borrow from money funds or from an inter-dealer market to finance short-term projects (e.g. repo to hedge funds). Due to investment mandates, money funds allocate funds only between bank claims and Treasury securities, while other investors have preferred-habitat demand for Treasuries. At quarter-end, bank balance-sheet constraints raise the cost of bank funding and reduce banks' borrowing from money funds. Money funds are left with excess liquidity and reallocate toward Treasury securities, increasing demand and lowering Treasury yields. Arbitrageurs can partially offset the price movement, but doing so requires balance-sheet capacity across the reporting date. When that capacity is costly, the predictable demand shock is not fully arbitraged away. The model delivers three empirical predictions: Treasury bill yields should fall at quarter-end; money funds should reduce bank-facing exposures and substitute into government money-like assets; and Treasury price movements should be stronger when predicted money-fund demand pressure is larger.

We verify the mechanism using monthly portfolio holdings from Form N-MFP filings, which report the complete security-level portfolios of all U.S. money market funds at month-end. The data reveal a sawtooth pattern in funds' bank-debt exposures: holdings contract sharply at each quarter-end and rebound the following month. The decline is concentrated among non-U.S. banks, especially those headquartered in the euro area, the United Kingdom, and Japan, whose leverage ratios are measured from quarter-end snapshots rather than daily averages. In aggregate, the quarter-end contraction amounts to roughly $100

billion, split between secured and unsecured instruments. The withdrawn cash does not leave the funds through investor redemptions; instead, it flows into government money-like assets, predominantly Treasury bills and the Federal Reserve's overnight reverse repurchase facility. A within-fund analysis confirms the substitution directly: funds that reduce bank-funding exposures at quarter-end increase their Treasury holdings within the same reporting month. In total, MMF Treasury holdings rise by roughly $30 billion at quarter-ends, of which roughly $10–14 billion is directly attributable to the substitution out of bank funding, with the remainder reflecting a larger share of contemporaneous fund inflows directed into Treasuries—large enough to generate the yield movements we document.

Beyond documenting a novel pricing pattern and providing qualitative evidence on its underlying mechanism, the paper makes a methodological contribution by constructing a network-composed shift-share exposure that traces quarter-end bank liability shocks through money market funds into maturity-specific Treasury demand and prices. Specifically, our shift-share design combines predetermined fund–bank lending relationships with predetermined fund-level Treasury allocations across maturities. The first layer maps bank-specific liability contractions into predicted reallocations by individual funds, while the second maps those reallocations into demand pressure at each Treasury tenor. By exploiting predetermined paths through the bank–fund–Treasury network, the design generates plausibly exogenous variation in Treasury demand across maturities that is orthogonal to contemporaneous Treasury market conditions, allowing us to estimate its causal price impact. We find that a demand inflow equal to 1% of outstanding market value lowers Treasury bill yield spreads by 4.9 basis points. This result is robust to alternative lag structures, subsample definitions, placebo tests, and weaker identification assumptions.

This new quantitatively-identified channel has direct implications for how policymakers and the U.S. Treasury should think about the demand curve for short-term public debt. Our results show that Treasury demand is not perfectly elastic, even in the deepest and most liquid segment of the Treasury market. The marginal buyers of Treasury bills are regulated cash investors with narrow portfolio mandates, and their demand for bills rises and falls with the supply of private money-like assets available to them. When banks curtail private money creation, money market funds are pushed into bills and yields fall; when Treasury bill supply

expands, the same constrained investor base must absorb it, and yields should rise.

We explore the policy implications of this mechanism through two counterfactual exercises. First, exploiting the predictable decline in Treasury bill yields around quarter-end reporting dates, we quantify the potential interest savings from concentrating Treasury bill auctions around quarter-ends rather than distributing issuance uniformly over the quarter. Second, using our estimated price multiplier, we evaluate how Treasury financing costs vary under alternative issuance scenarios. Our estimates imply that a bill-heavy issuance strategy leads to meaningfully higher financing costs than would be predicted under the conventional assumption of a perfectly elastic demand curve for Treasury bills.

Literature Our paper contributes to the emerging literature on market macrostructure, which studies how the identities, mandates, and constraints of large institutions shape asset prices (Haddad and Muir, 2025). Existing work shows that institutional demand matters in segmented bond markets and preferred-habitat environments (Vayanos and Vila, 2021; Greenwood et al., 2023), and demand-system approaches further show that heterogeneous institutional demand elasticities are important for asset pricing more broadly (Koijen and Yogo, 2019; Gabaix and Koijen, 2021). Recent work applies this lens to Treasury markets, documenting that institutional demand composition shapes yields across the maturity spectrum (Chaudhary et al., 2024; Jansen et al., 2024). We add to this literature by showing that regulated cash investors with narrow mandates are the marginal price-setters in the short-maturity Treasury market, and that their demand is not perfectly elastic with respect to the supply of private money-like assets.

The intermediary asset-pricing literature highlights how fluctuations in intermediaries' risk-bearing capacity and balance-sheet constraints affect risk premia, arbitrage wedges, and market dislocations (He and Krishnamurthy, 2013; Adrian et al., 2014; He et al., 2017; Haddad and Muir, 2021; Baron and Muir, 2022). Closest to our setting, post-crisis leverage regulation and quarter-end reporting incentives have been shown to generate covered-interest-parity deviations, negative swap spreads, and other arbitrage wedges (Du et al., 2018b; J Jermann, 2020; Boyarchenko et al., 2018; Du et al., 2023; Fleckenstein and Longstaff, 2020a). We add to this literature by showing that the same regulatory friction operates not

only through the supply of arbitrage capital but also through the demand of nonbank cash investors, generating a distinct and quantitatively important channel through which bank regulation affects asset prices.

This paper also relates closely to the literature documenting anomalies in the U.S. Treasury market. One strand of this literature focuses on timing around auction cycles. Krishnamurthy (2002) document positive profits from a strategy that goes long the old 30-year Treasury bond and short the newly issued 30-year bond. Similarly, Lou et al. (2013) show that newly issued medium- and long-term Treasury securities trade at a premium relative to otherwise similar seasoned securities in the secondary market, i.e., the well-known on-the-run versus off-the-run premium. Christensen et al. (2020) document similar patterns in the TIPS market, while Vayanos and Weill (2008) provide a search-based framework to rationalize these pricing differences. Another strand of the literature studies arbitrage trades using synthetic replication strategies. Fleckenstein et al. (2014) and Fleckenstein and Longstaff (2020b) show that constructing synthetic TIPS and FRN using nominal Treasuries generates a persistent price gap relative to actual securities. Similarly, Du et al. (2018a) document persistent deviations from covered interest parity by comparing U.S. Treasury yields with synthetic Treasury yields constructed from foreign government bonds and FX forward markets. We contribute to this literature in two ways. First, we focus on short-term Treasury securities, whereas most existing evidence concentrates on longer maturities, which are typically less liquid. Second, we study pricing dynamics around a series of different but repeated events rather than the auction cycles.

Our paper also contributes to the literature on public and private money-like assets. This literature views Treasury bills and other short-term government liabilities as public money-like assets that provide safety and liquidity services, while deposits, repo, commercial paper, certificates of deposit, and other short-term intermediary liabilities are private money-like assets that supply related but imperfectly substitutable services (Gorton and Pennacchi, 1990; Krishnamurthy and Vissing-Jorgensen, 2012; Sunderam, 2015; Nagel, 2016; Krishnamurthy and Li, 2022). Theoretical work emphasizes that private liquidity provision may be insufficient, creating a role for public liquidity (Holmström and Tirole, 1998), but also that private money creation can be excessive when short-term intermediary debt creates run

or fire-sale externalities (Stein, 2012). Related work argues that the government can use short-term public debt issuance to crowd out socially costly private money creation (Greenwood et al., 2015), and recent work documents that Treasury-bill scarcity affects the pricing of short-term near-money assets (d'Avernas and Vandeweyer, 2023) and that the relative supply of public and private money-like assets shapes the yield differential between them (Stein and Wallen, 2025). We add to this literature by documenting the reverse channel at high frequency: a regulatory reduction in private money-like assets supplied by banks crowds money market funds into public money-like assets, generating measurable price pressure in the Treasury bill market.

There is also a large literature on unintended consequences of bank regulation on asset prices. For regulations around quarter-ends, on the one hand, Munyan (2017) documents that foreign-owned broker-dealers reduce U.S. tri-party repo borrowing at quarter-end and reverse these positions immediately afterward, linking this pattern to leverage ratio requirements; Correa et al. (2020) and Copeland et al. (2025) document related patterns in U.S. repo and reserve markets. Bassi et al. (2024) complement this analysis by focusing on euro repo markets. On the other hand, several papers study spillovers to other markets. For example, Du et al. (2018b) show that deviations from covered interest parity (CIP) are most pronounced around quarter-end. By using granular datasets, Aldasoro et al. (2022), Kloks et al. (2024), Wallen (2020), and Du et al. (2025) further examine how reductions in repo activity affect FX swap prices. Our paper contributes to this literature in two ways. First, we show that not only repo funding declines at quarter-end, but unsecured funding instruments also contract. Second, we document that these balance sheet adjustments spill over into the U.S. Treasury market through money market funds' portfolio reallocation, complementing studies to FX swap markets.

Our paper also contributes to the growing literature applying shift-share designs in financial economics. Building on the methodological foundations of Adao et al. (2019), Goldsmith-Pinkham et al. (2020), and Borusyak et al. (2022), existing finance applications typically map institution-level shocks to borrowers, geographic markets, or individual securities through a single predetermined exposure matrix. Examples include allocating bank-level credit-supply shocks across geographic markets using local lending shares (Greenstone et al.,

2020), interacting predetermined county–industry shares with national industry-level trends in small-business employment (Brennecke et al., 2025), mapping money market fund outflows to banks through their pre-existing exposures to fund complexes (Anderson et al., 2025), and allocating fund-level flow shocks across securities using lagged portfolio holdings (Chaudhary et al., 2023; Fang, 2023). We extend this approach by constructing exposures from two linked financial networks. Predetermined fund–bank lending relationships first map bank-specific quarter-end liability contractions into predicted fund-level reallocations, while predetermined fund-level Treasury allocations map these reallocations into maturity-specific demand pressure. Algebraically, the resulting exposure can be represented as a conventional shift-share object with effective bank-to-bill tenor weights; methodologically, its distinctive feature is that these weights are obtained by composing two predetermined exposure matrices. Whereas a conventional one-layer shift-share design identifies the effect of shocks on directly exposed units, it generally leaves the intermediate transmission path implicit. Our network-composed design makes this path explicit, allowing us to trace and quantify how shocks originating in one segment of the financial system propagate through institutional balance sheets and spill over into prices in another asset class.

The rest of the paper is organized as follows. Section 2 provides institutional background and describes the data. Section 3 documents the quarter-end yield drop. Section 4 presents a simple model to guide the findings on Treasury yields. Section 5 analyzes the portfolio holdings of money market funds around quarter-end. Section 6 constructs a proxy for window-dressing intensity and quantifies its impact on Treasury prices. Section 7 draws out the debt-management and policy implications, calibrating the fiscal cost of bill-heavy funding. Section 8 concludes.

2 Institutional Background and Data

This section describes the institutional details of the short-term Treasury market. We first discuss its main participants and the mandates that shape their behavior, and then the data we use to measure short-term Treasury prices and money market fund portfolio reallocation.

Short-term U.S. Treasury Securities We define the short-term Treasury universe as marketable nominal Treasury securities with one year or less remaining to maturity. This universe includes Treasury bills as well as originally longer-maturity notes and bonds that have rolled down to the front end of the curve.[2] Treasury bills are central to our analysis because they are issued directly at short maturities, sold at a discount or at par, and redeemed at face value at maturity.[3] Regular bills are issued at 4-, 8-, 13-, 26-, and 52-week maturities (a 17-week tenor was added in 2022), while cash-management bills are issued irregularly to meet short-run financing needs.

The Treasury bill market is large and central to government financing. By the end of 2025, the amount of bills outstanding exceeded $6.6 trillion. Its investor base is distinct from that of longer-maturity Treasuries. According to Jansen et al. (2024), short-term Treasuries are held primarily by U.S. money market funds (MMFs), U.S. nonfinancial investors, and official institutions. MMFs have held the largest average share since 2012, accounting for roughly one-third of all outstanding short-term Treasury securities. In contrast, dealers and hedge funds play a substantially smaller role in this segment than in intermediate- and long-maturity Treasury markets. Jansen et al. (2024) further show that MMFs are the key marginal investors absorbing changes in Treasury bill supply. Figure B.21 shows that U.S. MMFs' footprint is most pronounced in Treasury bills, especially in the 0–6 month maturity range.

Money Market Funds Money market funds (MMFs) are regulated cash-management vehicles that invest in short-term, high-quality money-market instruments. As of 2024Q4, U.S. MMFs managed approximately $7.4 trillion in assets. MMFs are commonly classified into government, prime, and tax-exempt funds, as well as retail and institutional share classes. Government money market funds invest primarily in Treasury securities, government agency securities, cash, and repos collateralized by government securities, whereas prime

[2]We exclude TIPS and FRNs from the price analysis. FRNs carry a floating coupon that resets to the 13-week bill rate, so the fixed-rate spread we use—the yield over the federal funds lower bound—is not directly comparable across FRNs and conventional bills and notes; TIPS are inflation-indexed and trade in an institutionally distinct market from the nominal Treasuries we study.

[3]Figure B.23 plots the composition of Treasury securities with remaining maturity below one year and shows that bills are the dominant component of this short-maturity universe. Additional details on Treasury auction mechanisms are provided in Appendix B.6.3.

funds may also invest in private money-market instruments such as commercial paper and certificates of deposit.

MMF portfolio choices are shaped by SEC Rule 2a-7, which imposes maturity, liquidity, and diversification requirements. In particular, MMFs generally may not acquire securities with remaining maturity greater than 397 days, must maintain a weighted average maturity (WAM) of no more than 60 days, and a weighted average life (WAL) of no more than 120 days. The rule also imposes issuer-concentration limits and requires funds to maintain minimum levels of daily and weekly liquid assets. These restrictions concentrate MMF portfolios in short-term government securities and money-market instruments and make MMFs natural investors in Treasury bills. Figure B.1 provides a snapshot of MMF asset allocations at the end of 2024.

Data Our empirical analysis combines daily security-level Treasury prices with monthly security-level MMF portfolio holdings. For Treasury prices, we use the CRSP daily U.S. Treasury security file from January 2012 to December 2024. The file covers outstanding marketable Treasury securities and reports, for each security and trading day, end-of-day yields, prices, duration, amount outstanding, coupon rate, CUSIP, issue date, maturity date, and security type. We merge the CRSP Treasury file with TreasuryDirect auction data, from which we construct issuance amounts by tenor bucket to control for new-supply effects, and with a daily series on the lower bound of the federal funds target range to control for changes in the policy-rate environment. We restrict the sample to Treasury securities with remaining maturity of one year or less—Treasury bills plus originally longer-maturity notes and bonds that have rolled down to the front end.

For MMF holdings, we use monthly Form N-MFP filings submitted to the Securities and Exchange Commission by U.S. money market funds. These filings report each fund's complete portfolio holdings as of the final business day of the month. We obtain all N-MFP filings from EDGAR for 2012 through 2024 and classify each position into a major asset category: Treasury securities, agency securities, repurchase agreements, commercial paper, certificates of deposit, time deposits, municipal securities, and Federal Reserve overnight reverse repurchase agreements. For private money-market instruments, we standardize issuer

names and map each issuer to its ultimate parent, country of domicile, and bank-or-nonbank status. For repo positions, we observe the counterparty identity and collateral information.

The two datasets differ in frequency, which is central to our empirical design. The CRSP Treasury data allow us to measure daily yield dynamics around quarter-end reporting dates, while the N-MFP data allow us to observe month-end portfolio reallocations across asset classes, issuers, and counterparties. We therefore use the daily Treasury data to identify the timing and magnitude of price effects, and the monthly holdings data to trace the underlying portfolio substitution mechanism. Our main price-impact tests use the common January 2012–December 2024 sample. Additional details on issuer-name cleaning, parent mapping, and asset-class classification are provided in Appendix C.

3 The Quarter-End Short-Term Yield Pattern

We begin with the central pricing fact: short-maturity Treasury yields fall systematically at quarter-ends. The result is descriptive but robust—it holds conditional on a rich set of security- and market-level controls and survives a battery of robustness checks. We develop the mechanism linking it to MMF portfolio reallocation in Sections 5 and 6.

3.1 Empirical Specification

For each Treasury security i and trading day t, we define the security-level Treasury yield spread as the difference between security i's yield and the contemporaneous lower bound of the federal funds target range:

$$\text{Spread}_{i,t} \;=\; \text{Yield}_{i,t} \;-\; \text{FedFundsLB}_t. \tag{1}$$

This construction strips out the deterministic component of short-term rates driven by monetary policy and preserves the residual variation attributable to market-specific factors at the front end of the Treasury curve.[4]

[4]The time series of the cross-sectional spread distribution, partitioned into three remaining-maturity buckets (0–3, 3–6, and 6–12 months), is reported in Appendix B.2.1 (Figure B.4).

We then define an indicator QEnd_t equal to one on the last trading day of each calendar quarter and zero otherwise, and estimate

$$\text{Spread}_{i,t} \;=\; \beta\,\text{QEnd}_t \;+\; \gamma' X_{i,t} \;+\; \delta' Z_t \;+\; \lambda_{k(i)} \times q(t) \;+\; \varepsilon_{i,t}, \tag{2}$$

where $X_{i,t}$ collects security-level controls,[5] Z_t collects market-level controls, and $\lambda_{k(i)} \times q(t)$ denotes issuance-type-by-year-quarter fixed effects, with $k(i) \in \{\text{bill}, \text{note}, \text{bond}\}$ and $q(t)$ the calendar year-quarter containing day t. Standard errors are clustered at the issuance-type-by-year-quarter level. The coefficient of interest is β, which measures the average quarter-end change in the spread relative to other trading days; a negative β indicates a quarter-end yield drop.

Table 1 reports the estimates for three remaining-maturity buckets and two complementary samples. Panel A uses Treasury bills only—the universe most directly relevant to MMF demand and our focus throughout—while Panel B adds rolled-down notes and bonds with one year or less remaining maturity. Two patterns stand out. First, the quarter-end coefficient is negative in every cell and declines monotonically with remaining maturity: in the bills-only sample it is roughly 5–6 basis points at 0–3 months, 3–4 at 3–6 months, and 3 at 6–12 months (insignificant at the longest tenor), with comparable but larger magnitudes (9, 4, and 3 basis points) in the pooled sample. Second, the effect at the shortest tenor is larger in Panel B than in Panel A, indicating that rolled-down coupon securities—thinner in secondary-market liquidity than freshly issued bills—contribute disproportionately to the 0–3 month drop. The common maturity gradient is consistent with the anomaly operating through MMFs, the marginal short-Treasury investor, whose demand is concentrated at the front end.

The estimates are robust to a range of additional checks, collected in Appendix B.2: splitting the sample at the 2015 phase-in of foreign-bank Basel III leverage-ratio disclosure (Appendix B.2.2, which also discusses the SEC's 2014 MMF reform); restricting the comparison group to month-end trading days (Appendix B.2.3); allowing the effect to vary by cal-

[5] We omit the coupon rate from $X_{i,t}$ because it is absorbed by the issuance-type-by-year-quarter fixed effects: within a given issuance-type-quarter cell, T-bill coupons are zero and Treasury-note coupons are fixed at issuance, so the within-cell variation is essentially nil.

endar quarter (Appendix B.2.4); decomposing the pooled effect by security type and original tenor (Appendix B.2.8); and separating the effect across zero-lower-bound and positive-rate periods, where it is concentrated in the latter (Appendix B.2.10).

Table 1: Quarter-End Effect on Short-Term Treasury Spreads

Dependent Variable:	Spread (pp)					
Sample:	Panel A. T-bills only			Panel B. Notes + Bonds + Bills		
Remaining maturity:	0–3 m	3–6 m	6–12 m	0–3 m	3–6 m	6–12 m
QEnd_t	-0.0565^{***}	-0.0359^{**}	-0.0344	-0.0912^{***}	-0.0412^{***}	-0.0303^{*}
	(0.0182)	(0.0160)	(0.0218)	(0.0184)	(0.0116)	(0.0172)
Issuance × Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Security controls	Yes	Yes	Yes	Yes	Yes	Yes
Market-level controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	60,467	48,742	24,899	99,526	88,176	106,261
R^2	0.244	0.752	0.827	0.187	0.747	0.845
Within R^2	0.065	0.037	0.021	0.017	0.032	0.027

Notes: OLS estimates of equation (2) on the full daily sample, January 2012 through December 2024. Security-level controls $X_{i,t}$ are duration and the bid–ask spread; market-level controls Z_t are the dollar volume of newly auctioned Treasury bills and the face amount of Treasury debt maturing on day t. Standard errors, clustered at the issuance-type-by-year-quarter level, are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

3.2 Event-Window Analysis

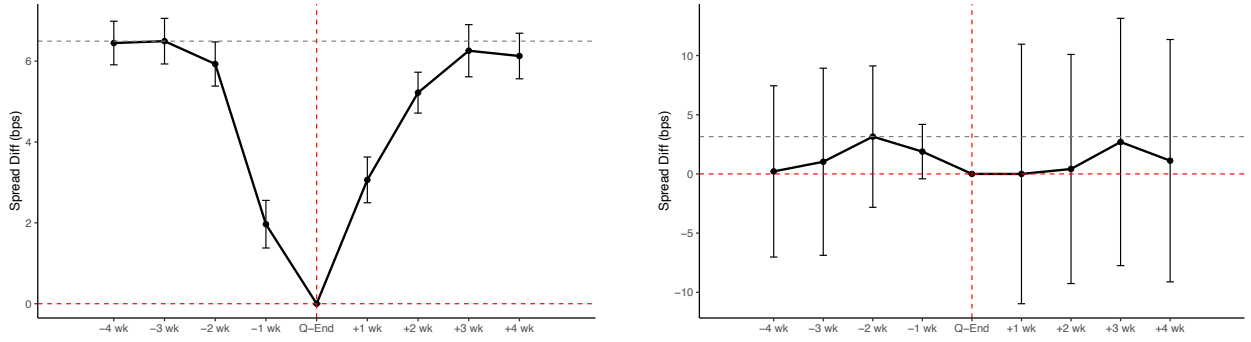
To shed more light on the dynamics around quarter-ends, we construct an event-window panel in which each quarter-end week is compared to adjacent non-quarter-end weeks in the same, previous, or next quarter, indexed by offsets $k \in \{-4, \ldots, +4\}$ weeks. For each k and each remaining-maturity bucket, we estimate

$$\text{Spread}_{i,t} = \beta_k \, \text{QEnd}_t + \gamma' X_{i,t} + \delta' Z_t + q(t) + \varepsilon_{i,t}, \tag{3}$$

where QEnd_t equals one for observations in the quarter-end week and zero for those in the offset-k week, $X_{i,t}$ and Z_t are the security- and market-level controls of equation (2), and $q(t)$ denotes year-quarter fixed effects. By construction, this design identifies β_k from a short-window contrast that holds the monetary policy regime, macroeconomic conditions, and aggregate Treasury supply approximately fixed.

Figure 1 traces out a pronounced V-shape in the entire Treasury-bill sample over the full 2012–2024 window: spreads are lowest in the quarter-end week and rise on either side, with a trough of roughly 6 basis points in absolute magnitude and tight confidence bands, in line with the overall bills-only point estimate in Panel A of Table 1. Notably, the trough does not appear abruptly at the quarter-end: spreads begin declining roughly two weeks in advance, consistent with the slow-moving capital widely documented in the literature [6] . The right panel reports a placebo estimated on Treasury notes with more than one year remaining maturity, which shows no comparable quarter-end V-shape—consistent with the effect being concentrated in the short-maturity bills held by MMFs rather than a generic quarter-end phenomenon across the Treasury curve.

Figure 1: Event-Study around Quarter-Ends: T-bills and Notes Placebo



T-bills

Placebo: Notes (≥1y), pooled

Notes: This figure plots the event-window coefficients $-\hat{\beta}_k$ from equation (3) for $k \in \{-4, \ldots, +4\}$ weeks relative to quarter-end, with the quarter-end week normalized to zero. The left panel uses the entire Treasury bills sample; the right panel is a placebo estimated on Treasury notes with more than one year remaining maturity (pooled). Error bars are 95% confidence intervals. The sample spans January 2012 through December 2024.

[6] In practice, MMFs reduce their bank exposure ahead of quarter-end not by selling positions—the secondary markets for banks' short-term liabilities are over-the-counter and relatively illiquid—but by letting maturing instruments run off without rolling them over, so the timing of the withdrawal tracks the tenor of each funding leg. Unsecured bank debt is comparatively long-dated: the median original tenor is about 80 days for certificates of deposit and time deposits (CD/TD) and for financial commercial paper, with a 25th percentile of 9 and 32 days, respectively. Because this market is large, even the shortest quartile is a substantial dollar amount maturing in the one-to-two weeks before quarter-end, and the freed cash flows into Treasuries over that window, producing the gradual pre-trend. Repo, by contrast, is overwhelmingly short-dated—a median original tenor of roughly two days for Treasury and Agency repo and a 25th percentile of one day—so positions are unwound and re-established quickly, around and just after quarter-end, rather than over an extended pre-window.

Separate event-window plots by remaining-maturity bucket, together with the notes-only and bonds-only placebo tests, are reported in Appendix B.2.9. The V-shape is present in every Treasury-bill maturity bucket but flattens and loses precision as remaining maturity rises, while neither placebo exhibits a comparable quarter-end pattern.

Taken together, the evidence in this section establishes the central empirical price fact of the paper: short-maturity Treasury yields fall by roughly 3–9 basis points on quarter-end days, with the largest effect at 0–3 months and a monotonic decline across remaining maturities. The pattern shows up both in the broader sample of all noncallable short-maturity Treasuries and in the bills-only sample, and is robust to a wide range of alternative samples and specifications.

4 A Simple Model

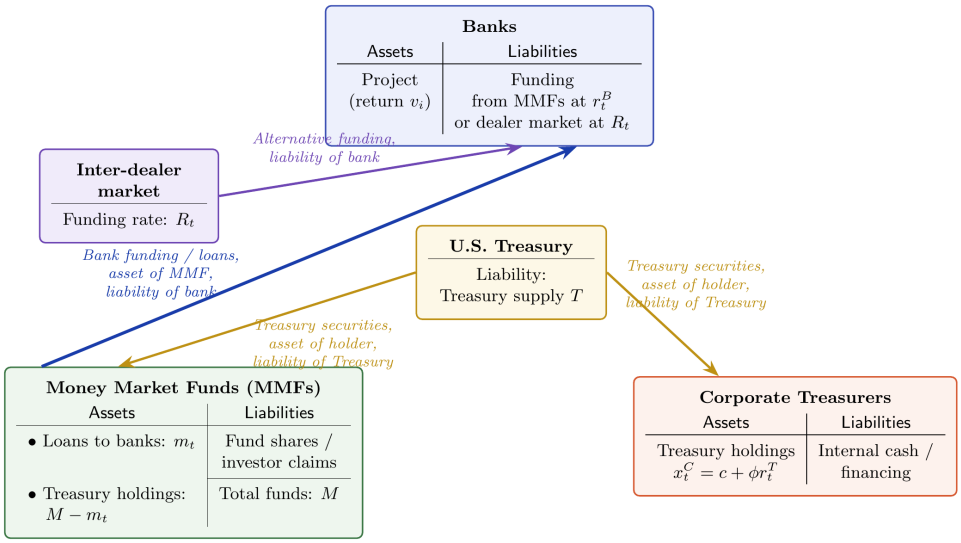
Having documented the quarter-end yield drop, we now present a simple model that rationalizes it and organizes the rest of the empirical analysis. Beyond this price fact, the model delivers two further predictions, on money-fund portfolios and on Treasury prices, that we test in Sections 5 and 6. Time is discrete with two periods, $t \in \{0, 1\}$. We interpret $t = 0$ as the inter-quarter period and $t = 1$ as the quarter-end. There are three types of agents: (i) banks with total mass B, (ii) money market funds with total mass 1, and (iii) corporate treasurers with total mass 1. For simplicity, we assume a unit discount factor across periods for all agents.

Banks are short-lived agents that seek funding to finance an indivisible project that requires a one-dollar investment. They are heterogeneous in their project returns: each bank $i \in I$ generates payoff v_i, where v_i is drawn from an exogenous distribution $F(\cdot)$. We assume $F(\cdot)$ is a continuous and strictly increasing cumulative distribution function; existence and uniqueness of equilibrium are established below. After observing v_i, a bank chooses whether to finance its project by borrowing in the inter-dealer market at rate R_t, or from money market funds at rate $r^B_{i,t}$. The rate $r^B_{i,t}$ is determined via bilateral bargaining.

Money market funds are homogeneous, short-lived agents endowed with M dollars at the beginning of each period. To preserve capital and generate returns for shareholders,

they allocate funds between Treasury securities with yield r_t^T and loans to banks at the negotiated rate $r_{i,t}^B$. Corporate treasurers are preferred-habitat investors, modeled as in Vayanos and Vila (2021), with an exogenous demand for Treasury securities. The model setup is summarized in Figure 2; we discuss our modeling choices further in Appendix A.

Figure 2: Model Illustration



Bank–Fund Bargaining We first solve for the equilibrium rate between banks and money funds. The negotiated rate is determined via Nash bargaining:

$$\max_{r_{i,t}^B} \left[(v_i - r_{i,t}^B) - (v_i - R_t)\right]^{\alpha} \left[r_{i,t}^B - r_t^T\right]^{1-\alpha}. \tag{4}$$

The first term captures the bank's surplus from borrowing from the fund rather than the dealer market, while the second term captures the fund's surplus from lending to the bank instead of investing in Treasuries. Since the disagreement payoffs do not depend on i, the equilibrium rate is identical across banks:

$$r_t^B = (1-\alpha)R_t + \alpha r_t^T. \tag{5}$$

Bank Borrowing Not all banks choose to borrow. The participation constraint is $v_i - r_t^B > 0$, implying that in equilibrium the total borrowing is:

$$m_t = B\big(1 - F(r_t^B)\big). \tag{6}$$

Treasury Market Let total Treasury supply be T. Corporate treasurer demand is given by $x_t^c = c + \phi r_t^T$. Market clearing implies:

$$T = \underbrace{c + \phi r_t^T}_{\text{corporate demand}} + \underbrace{M - m_t}_{\text{money fund demand}}. \tag{7}$$

Lemma 1 *For each $t \in \{0, 1\}$, there exists a unique equilibrium $\{r_t^B, r_t^T, m_t\}$.*

Combining (5)–(7), we obtain:

$$m_t = B\left(1 - F\left((1-\alpha)R_t + \alpha\left(\frac{T - c - M}{\phi} + \frac{m_t}{\phi}\right)\right)\right). \tag{8}$$

Because the right-hand side is continuous and nonincreasing in m_t while the left-hand side is strictly increasing in m_t, a unique fixed point m_t exists.

Quarter-End Shock We now introduce a quarter-end funding shock by assuming $R_1 > R_0$, reflecting tighter conditions in the inter-dealer market due to window dressing.[7] This yields:

Proposition 1 $r_1^B > r_0^B, \quad m_1 < m_0, \quad$ *and* $\quad r_1^T < r_0^T$.

The intuition is as follows. At quarter-end, balance-sheet constraints reduce inter-dealer lending, raising R_t. This increases the outside option for money funds and raises the negotiated borrowing rate r_t^B. Higher funding costs reduce bank borrowing ($m_1 < m_0$), leaving money funds with excess liquidity. This liquidity is reallocated into Treasuries, increasing demand and lowering equilibrium yields ($r_1^T < r_0^T$).

[7] $R_1 > R_0$ can be interpreted as a higher borrowing rate in interdealer markets, either collateralized or uncollateralized. In practice, collateralized interdealer borrowing can occur in several markets, including (i) the GCF repo market, (ii) the FICC DVP repo market, and (iii) private bilateral repo markets. Due to data limitations, Figure B.3 plots only the GCF repo market rate.

Arbitrageurs We now introduce arbitrageurs, who operate across both periods and exploit predictable price movements. Anticipating higher Treasury prices (lower yields) at quarter-end, arbitrageurs take offsetting positions against money funds.

Let s denote the arbitrageur's Treasury position and W its initial wealth. Due to frictions[8], arbitrageurs incur a convex cost $c(s; R_1)$ when building positions. The cost depends on the funding rate R_1, which reflects funding-market conditions at quarter-end (Du et al., 2018b). Their problem is:

$$\max_s (p_1 - p_0)s + [W - sp_0](R_0 - 1) - c(s; R_1), \tag{9}$$

where Treasury prices and yields satisfy (with r_t^T and R_t interpreted as gross rates):

$$p_t = \frac{1}{r_t^T}.$$

Assuming $c(s) = \frac{1}{2\eta(R_1)}s^2$ with $\eta(R_1) > 0, \eta'(R_1) < 0$, the first-order condition yields:

$$s = \eta(R_1)\left(\frac{1}{r_1^T} - \frac{R_0}{r_0^T}\right). \tag{10}$$

Proposition 2 *A lower R_1 reduces the equilibrium yield spread $r_0^T - r_1^T$.*

Intuitively, a lower R_1 means a larger η, which implies more elastic arbitrage demand. Arbitrageurs take larger positions for a given intertemporal price difference, increasing demand in period 0 and supply in period 1. This compresses the cross-period yield differential in equilibrium.

Interpretation The model captures quarter-end window dressing in reduced form, through the exogenous rise in the inter-dealer rate ($R_1 > R_0$). Banks therefore cut borrowing on the price margin—a higher R raises the negotiated rate r_t^B and prices out marginal banks—rather than by directly shrinking their balance sheets to improve a leverage-ratio snapshot. In practice both forces operate, and a constrained bank may curtail quarter-end funding even at an unchanged rate. Adding an explicit quarter-end balance-sheet cost to banks would in-

[8]We discuss the interpretation of these frictions in Appendix A.

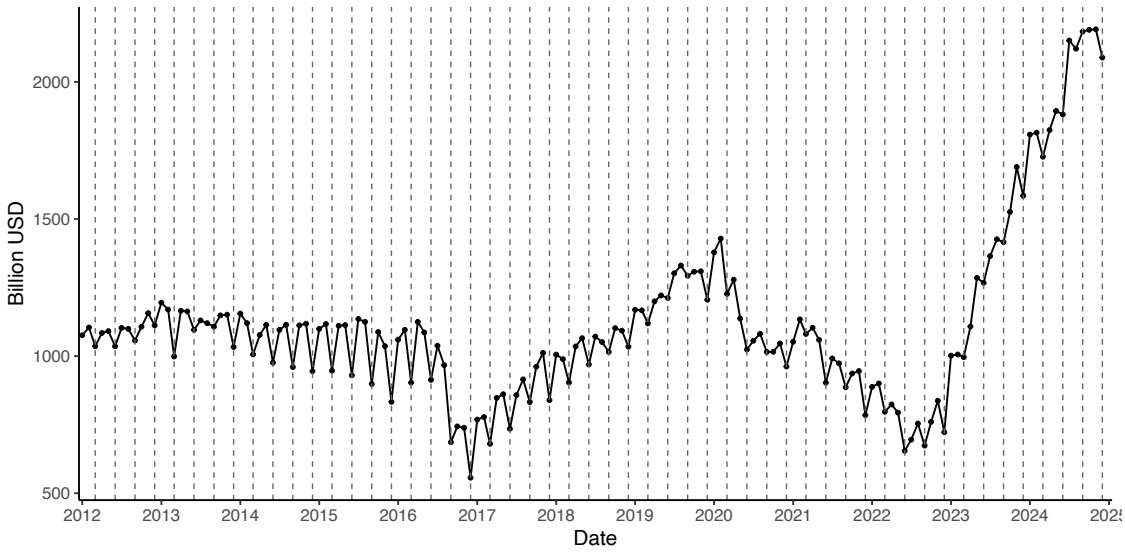
troduce this quantity channel alongside the price channel and reinforce the same predictions ($m_1 < m_0$ and $r_1^T < r_0^T$). We further discuss our modeling choices in the appendix.

5 MMF Portfolio Reallocation around Quarter-Ends

5.1 Magnitude of the Window-Dressing Contraction

Non-U.S. banks have incentives to compress balance-sheet-intensive activities around regulatory reporting dates to appear less leveraged, because leverage ratios and related metrics are measured from quarter-end snapshots of their balance sheets. Figure 3 plots aggregate MMF holdings of bank debt[9] with dashed vertical lines marking quarter-end dates. The series traces a pronounced *sawtooth* pattern: MMF holdings of bank debt fall sharply at each quarter-end and rebound the following month, quarter after quarter throughout the sample.

Figure 3: Aggregate Bank Debt Holdings by MMFs



Notes: The figure plots aggregate MMF holdings of bank debt at month-ends; dashed vertical lines mark quarter-end months. The sample spans 2012–2024.

[9]Bank debt here includes both secured instruments (repurchase agreements collateralized by bank-pledged collateral) and unsecured instruments (commercial paper, certificates of deposit, and time deposits) issued by the bank.

The magnitudes are economically large. In non-quarter-end months, MMFs hold approximately $1.15 trillion of bank debt in aggregate, of which about $0.89 trillion is issued by non-U.S. banks. Table 2 reports the year-month regression estimates of aggregate holdings on a quarter-end indicator. At quarter-end, these holdings decline on average by roughly $96.6 billion, equivalent to 8.4% of total bank-debt holdings and 10.9% of foreign-bank holdings. The reduction is split almost evenly between repo ($52.5 billion) and unsecured instruments ($42.8 billion), each estimated in a separate regression and so not constrained to sum exactly to the total. Appendix B.3.1 presents complementary event-study evidence, confirming that the decline is concentrated around quarter-end dates.

Table 2: Aggregate Quarter-End Shrinkage in MMF Bank-Debt Holdings

Dependent Variable:	Aggregate market value ($ bn)		
Sample:	Repo	Unsecured	Total
QEnd_t	-52.54^{***}	-42.84^{***}	-96.57^{***}
	(7.925)	(7.290)	(10.85)
Year-Quarter FE	Yes	Yes	Yes
Observations	156	156	156
R^2	0.990	0.975	0.982

Notes: Year-month panel, one observation per month-end ($N = 156$). The dependent variable is the aggregate market value (in USD billions) of MMF holdings of bank-issued debt (Repo / Unsecured / Total), summed across all funds and bank issuers. Each column regresses the corresponding aggregate on the quarter-end indicator with Year-Quarter fixed effects, so β is identified from within-quarter variation. Standard errors in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

This window-dressing incentive is stronger for banks in jurisdictions that rely on quarter-end snapshots rather than period averages. Appendix B.3.2 decomposes the contraction by issuer region and by secured-versus-unsecured instrument and reports the corresponding event-window plots. These confirm that the quarter-end pattern is concentrated in non-U.S. banks—especially those headquartered in the Euro area, the UK, and Japan—and operates symmetrically across repo and unsecured funding.

5.2 Intensive- and Extensive-Margin Decomposition

To investigate these patterns, we decompose the quarter-end contraction into two margins. The *extensive* margin is the number of funds that leave the bank-funding market entirely at quarter-end; the *intensive* margin is the amount by which a fund that remains active reduces its position, conditional on continuing to invest in at least one bank through the quarter-end month. By an accounting identity, the change in total exposure is the sum of (i) the average change in position per fund, weighted by the number of active funds (the intensive margin), and (ii) the change in the number of active funds, weighted by the average position size (the extensive margin):

$$\Delta \text{Value}_t \;\approx\; \underbrace{\Delta\big(\text{average position per fund}\big)}_{\text{intensive}} \times N_{\text{fund}} \;+\; \underbrace{\Delta N_{\text{fund}}}_{\text{extensive}} \times \big(\text{average position per fund}\big). \tag{11}$$

We begin with the extensive margin. Table 3 estimates how many funds leave the bank-funding market entirely at quarter-end, regressing the count of active funds per month on the quarter-end indicator. The number of participating funds falls by about 1.56 for repo, 0.96 for unsecured debt, and 1.80 with both asset classes pooled, all statistically significant. At an average investment of about \$7.6 billion per fund-month, the pooled estimate implies a market-level extensive-margin reduction of roughly \$13.7 billion.

Table 3: Magnitude of Window Dressing: Extensive Margin (Active Funds per Month)

Dependent Variable (count of):	Active Funds per Month		
Panel:	Year-Month		
Asset Class:	Repo	Unsecured	Both
QEnd_t	-1.563^{***}	-0.9615^{***}	-1.798^{***}
	(0.5759)	(0.3423)	(0.6048)
Year-Quarter FE	Yes	Yes	Yes
Observations	156	156	156
R^2	0.987	0.998	0.994
Within R^2	0.314	0.139	0.163

Notes: This table aggregates the data to a year-month panel and regresses the number of unique money funds with a positive position in the indicated asset class at month-end t on QEnd_t, capturing aggregate fund participation in the bank-funding market. Standard errors in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

We next quantify the intensive margin, the reduction in position for a fund that remains active through the quarter-end month. We estimate a fund-month-level panel regression:

$$\text{Value}_{i,t} = \beta\, \text{QEnd}_t + \text{Controls}_{i,t} + \alpha_{i,q(t)} + \varepsilon_{i,t} \tag{12}$$

Table 4 reports the estimates and shows that MMFs significantly reduce their bank-funding exposures at quarter-end. The estimated coefficient on QEnd_t is negative and statistically significant across all specifications, implying that, within the same fund-year-quarter, quarter-end months are associated with reductions of about $0.35 billion in repo holdings, $0.57 billion in unsecured debt holdings, and $0.62 billion when both asset classes are pooled. The estimates are nearly identical whether holdings are measured using book value or market value, suggesting that the results are not driven by valuation differences. Across the roughly 140 unique funds with observations in both quarter-end and non-quarter-end months, aggregating the fund-level estimates implies an intensive-margin contraction on the order of $87 billion. Combining the two margins reproduces the order of magnitude of the directly measured aggregate quarter-end shrinkage of $96.6 billion.

Table 4: Magnitude of Window Dressing: Intensive Margin

Dependent Variables:	Book Value	Market Value	Book Value	Market Value	Book Value	Market Value
Asset Class:	Repo		Unsecured Debt		Both	
QEnd_t	-0.3449^{***}	-0.3448^{***}	-0.5734^{***}	-0.5718^{***}	-0.6248^{***}	-0.6240^{***}
	(0.0245)	(0.0245)	(0.0389)	(0.0389)	(0.0291)	(0.0291)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fund × Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	21,909	21,909	11,173	11,173	23,215	23,215
R^2	0.987	0.987	0.990	0.990	0.991	0.991
Within R^2	0.033	0.033	0.054	0.054	0.048	0.048

Notes: Fund-level OLS estimates of $\text{Value}_{i,t} = \beta\,\text{QEnd}_t + \text{Controls}_{i,t} + \alpha_{i,q(t)} + \varepsilon_{i,t}$, where i indexes a money fund, t indexes a month-end, and $\alpha_{i,q(t)}$ are Fund × Year-Quarter fixed effects. The dependent variable is the dollar amount (book or market value, in USD billions) that fund i holds in the indicated asset class at month-end t. Controls include security characteristics, weighted average maturity (WAM), credit ratings, fund size, fund age, and (for repo) collateral type, collateral days-to-maturity, and haircut. Standard errors in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

To assess robustness, we repeat this analysis on the fund–bank-level dataset in Appendix B.3.3. At that level, the extensive margin decomposes further into the decline in the number of funds per bank and the decline in the number of banks per fund, while the intensive margin becomes the within-pair contraction in a fund's exposure to a given bank. Both margins confirm the patterns documented here.

5.3 Where Does the Withdrawn Bank Funding Go?

By an accounting identity, the bank funding that MMFs withdraw must be reallocated somewhere: fund shareholders may redeem their shares; the money may shift to other private issuers that do not window-dress, such as U.S. banks or non-financial corporations; it may flow into other asset classes, such as municipal bonds, Treasuries, or the Federal Reserve's overnight reverse repurchase facility (RRP); or it may remain as cash. Table 5 estimates this reallocation across all candidate destinations at the fund-month level on a balanced panel. The quarter-end inflow is concentrated in Treasuries and the RRP: the typical fund shifts about \$0.14 billion into Treasuries and \$0.56 billion into the RRP at quarter-end, against small reductions in holdings of other private issuers (about \$0.04 billion) and municipal debt (about \$0.003 billion) and little change in cash.

Table 5: Where Does the Money Go? Quarter-End Reallocation Across Asset Classes

Dependent Variables:	Cash Account	NetFlow	Municipal Bonds	Other Issuers	Treasury	RRP
QEnd_t	0.0109*	0.0362	−0.0027***	−0.0362***	0.1360***	0.5563***
	(0.0057)	(0.0321)	(0.0010)	(0.0094)	(0.0262)	(0.0281)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fund × Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	31,445	31,445	31,445	31,445	31,445	31,445
R^2	0.917	0.360	0.969	0.970	0.989	0.974
Within R^2	0.0094	6.5×10^{-5}	0.0006	0.0354	0.0162	0.0480

Notes: OLS estimates of $\text{Quantity}_{i,t} = \beta\,\text{QEnd}_t + \text{Controls}_{i,t} + \alpha_{i,q(t)} + \varepsilon_{i,t}$ at the fund-month level, on a balanced panel. Each column uses a different dependent variable: the dollar position in the named asset class (in USD billions). The control is fund net flow, and all specifications include fund × year-quarter fixed effects. Standard errors in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

To identify the destination *within the same fund*, we relate the quarter-end change in a fund's holdings of each candidate government money-like asset to the contemporaneous change in its bank funding, controlling for the fund's net flow to strip out mechanical scaling from investor flows:

$$\Delta\text{Asset}_{i,t} = \beta\left(-\Delta\text{BankFunding}_{i,t}\right) + \delta\,\text{NetFlow}_{i,t} + \alpha_{i,y(t)} + \varepsilon_{i,t}, \tag{13}$$

estimated on quarter-end months, where Asset can be Treasury or RRP, $-\Delta\text{BankFunding}_{i,t}$ is the within-fund reduction in fund i's holdings of bank-issued repo and unsecured debt, $\text{NetFlow}_{i,t}$ is the fund's net flow (new investment minus redemptions), and $\alpha_{i,y(t)}$ are fund-by-year fixed effects. A positive β means that the dollars a fund pulls from bank funding flow into the named asset. We report the regression in both portfolio-share (percentage points of AUM) and dollar units.

Table 6 reports the estimates. Holding net flow fixed, each \$1 reduction in bank funding is associated with about \$0.11 more in Treasuries and \$0.60 more in RRP at the same fund; in share terms, the loadings are 0.17 and 0.27 percentage points of AUM. The RRP is the more elastic substitute, consistent with its role as an overnight, zero-duration parking facility, but Treasuries absorb an economically meaningful share of the reallocation—enough to move

prices in the bill market. Applying the \$0.11 Treasury loading to the aggregate quarter-end reduction in bank funding of \$96.6 billion implies roughly \$10 billion of predicted quarter-end Treasury demand. The positive and statistically significant coefficient on NetFlow reveals an additional channel through which MMFs increase their Treasury holdings at quarter-end. Importantly, Table 5 shows that aggregate MMF inflows do not rise significantly at quarter-end. Nevertheless, Table 6 indicates that the share of fund inflows allocated to Treasury securities increases significantly during these periods. Taken together, these results suggest that MMFs temporarily increase Treasury investments not only by reallocating funds away from bank debt displaced by quarter-end window dressing, but also by directing a larger fraction of contemporaneous cash inflows into Treasury securities.

Table 6: Where Does the Bank-Funding Dollar Go?

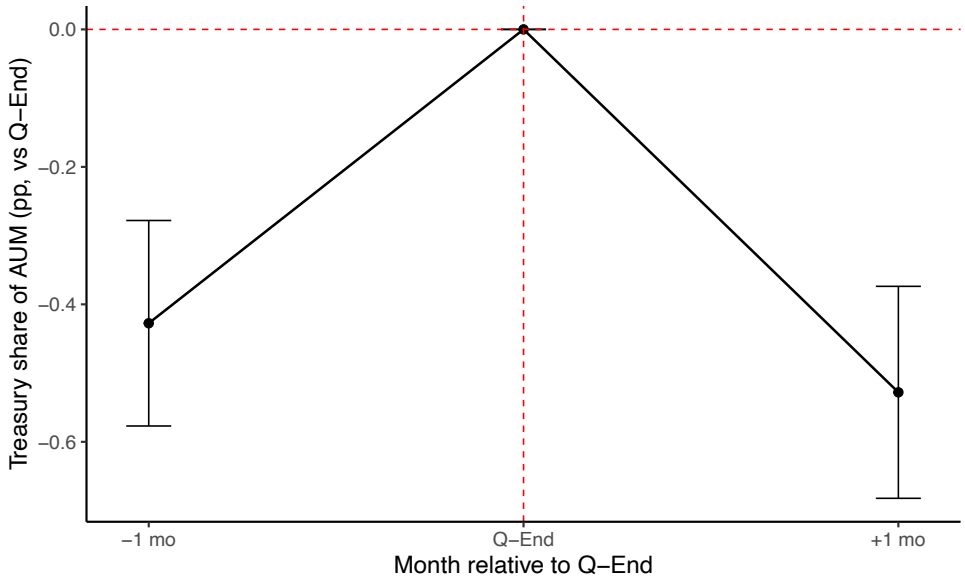
Dependent Variable:	Share of AUM (pp)		Dollars (\$bn)	
	Treasury	RRP	Treasury	RRP
Model:	(1)	(2)	(3)	(4)
$-\Delta$ BankFunding	0.168***	0.266***	0.106***	0.603***
	(0.012)	(0.018)	(0.023)	(0.037)
NetFlow	0.160***	0.204***	0.127***	0.490***
	(0.013)	(0.019)	(0.019)	(0.035)
Fund $\times$ Year FE	Yes	Yes	Yes	Yes
Observations	8,180	8,180	8,180	8,180
Within R^2	0.082	0.146	0.064	0.407

Notes: OLS estimates of equation (13) on quarter-end months. The dependent variable is the within-fund change in the named asset, as a share of lagged NAV (columns 1–2) or in dollars (columns 3–4). All specifications control for the fund's net flow and include fund $\times$ year fixed effects. Standard errors in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

The event-window view confirms the Treasury substitution directly. Figure 4 plots the fund-level Treasury share of AUM in event time around quarter-ends, holding fund identity and event-quarter fixed so that the aggregate flow channel is absorbed. The Treasury share peaks in the quarter-end month and is lower on either side: relative to a quarter-end share of about 34.0 pp, the typical fund's share is 0.43 pp (1.26%) lower one month before and 0.53 pp (1.55%) lower one month after. Because the share is normalized by fund AUM, this pattern only reflects portfolio-composition shifts rather than inflows into the fund. A quarter-end

lift of roughly half a percentage point in the Treasury share, applied to the aggregate assets under management of the funds in our sample (roughly $3 trillion on average over 2012–2024), implies about $14 billion of additional Treasury demand.

Figure 4: Treasury Share of MMF AUM Event Window



Notes: The figure plots the fund-level MMF Treasury share (Treasury holdings as a share of the fund's total securities, in percentage points) in event time, over a window of ±1 month around the quarter-end ($t = 0$, normalized to zero). The specification includes within-fund × event-quarter fixed effects, which absorb the AUM-flow channel. The sample spans 2012–2024, and error bars denote 95% confidence intervals.

The two flow-netted exercises agree on the magnitude of the substitution channel—roughly $10–14 billion of quarter-end Treasury demand. The unconditional estimates in Table 5, which additionally capture the reallocation of contemporaneous inflows, put the total quarter-end increase in MMF Treasury holdings at roughly $30 billion, consistent with the aggregate quarter-end increase observed in the holdings data. Appendix B.3.5 shows that the same-fund substitution is robust across sub-periods and reports the Treasury-share event windows estimated separately for government and prime MMFs.

6 Estimating the Treasury Price Multiplier

We now formally examine how banks' quarter-end window-dressing activities spill over to the short-maturity Treasury market and estimate the corresponding price multiplier. Because the model in Section 4 contains a single Treasury asset, we first derive its implied price pressure and then introduce the empirical identification of the price multiplier. Let $H_t \equiv M - m_t$ denote MMF holdings of Treasuries in period t. With arbitrageurs holding position s, the Treasury market-clearing conditions in the inter-quarter and quarter-end periods can be written as

$$T = c + \phi r_0^T + H_0 + s, \tag{14}$$

$$T = c + \phi r_1^T + H_1 - s, \tag{15}$$

A positive s means that arbitrageurs buy Treasuries before quarter-end and unwind the position at quarter-end. Subtracting the two market-clearing conditions gives

$$\Delta r^T = -\frac{\Delta H}{\phi} + \frac{2s}{\phi}, \tag{16}$$

where $\Delta r^T \equiv r_1^T - r_0^T$ and $\Delta H \equiv H_1 - H_0$. Equation (16) has two components. The first term captures MMF portfolio reallocation: when MMFs increase Treasury holdings at quarter-end, Treasury yields fall. The second term captures the arbitrageur offset: arbitrageurs attenuate the predictable yield movement but do not necessarily eliminate it, because taking positions across quarter-end requires scarce balance-sheet capacity.

Empirically, short-maturity Treasuries differ by remaining maturity, and money funds allocate the displaced cash across different tenor buckets. We therefore use the model to motivate a reduced-form relationship between predicted MMF demand pressure and short-maturity Treasury spread movements across tenors. Let τ denote a short-maturity Treasury tenor bucket in the empirical panel, t a month-end observation, and $q(t)$ the corresponding calendar quarter. Let $\Delta spread_{t,\tau}$ denote the quarter-end spread movement for tenor τ. The

empirical analogue of equation (16) is reduced-form:

$$\Delta spread_{t,\tau} = \beta \Delta \theta^{MMF}_{t,\tau} + \mathcal{A}_{t,\tau}, \tag{17}$$

where $\Delta \theta^{MMF}_{t,\tau}$ is MMF Treasury demand pressure in tenor τ, normalized by the outstanding size of that tenor. The term $\mathcal{A}_{t,\tau}$ collects the empirical counterpart of arbitrageur activity and other non-MMF pricing forces. We decompose this component as

$$\mathcal{A}_{t,\tau} = \alpha_t + \gamma_{\tau,q(t)} + \nu_{t,\tau}, \tag{18}$$

where the date fixed effects α_t absorb pricing shocks common to all tenors at a given month-end, including aggregate monetary-policy news, liquidity conditions, broad quarter-end effects, and the common component of arbitrage capacity. Tenor-by-quarter fixed effects $\gamma_{\tau,q(t)}$ absorb persistent tenor-specific differences in spread behavior and pricing conditions within a quarter. The residual $\nu_{t,\tau}$ captures remaining tenor-month pricing variation, including any residual arbitrageur response not absorbed by the fixed effects.

A regression on realized $\Delta \theta^{MMF}_{t,\tau}$ would be difficult to interpret causally, because realized Treasury holdings are equilibrium outcomes: yields affect MMF allocation, and unobserved Treasury-market shocks move both prices and holdings. Our strategy therefore uses predicted window-dressing-induced Treasury demand pressure directly as the regressor of interest. Specifically, we estimate

$$\Delta spread_{t,\tau} = \beta WDIT^{QE}_{t,\tau} + \alpha_t + \gamma_{\tau,q(t)} + X'_{t,\tau}\delta + \epsilon_{t,\tau}, \tag{19}$$

where $WDIT^{QE}_{t,\tau}$ denotes predicted quarter-end window-dressing-induced Treasury demand pressure in tenor τ, constructed below. The coefficient of interest, β, measures the reduced-form equilibrium price multiplier from predicted MMF demand pressure to short-maturity Treasury spread movements. It captures the average price response across tenors and quarter-ends, net of the arbitrageur response and other pricing forces absorbed by fixed effects and controls. If $WDIT^{QE}_{t,\tau}$ is measured in percentage points of total market size, then β can be interpreted as the change in the short-maturity Treasury spread, in basis points, associated

with a one-percentage-point change in $WDIT^{QE}_{t,\tau}$.

We construct $WDIT^{QE}_{t,\tau}$ in two steps. We first define a fund-level exposure to bank window-dressing shocks:

$$B_{i,t} = \sum_j \theta^{Bank}_{i,j,t-1} \times \Delta Debt_{j,t}, \tag{20}$$

where i indexes money market funds, j indexes banks, and $t-1$ denotes the month preceding the quarter-end. The term $\theta^{Bank}_{i,j,t-1}$ measures fund i's predetermined exposure to bank j's debt before the quarter-end window. The bank-level shift, $\Delta Debt_{j,t}$, is the quarter-end reduction in bank j's debt. Because a quarter-end contraction makes $\Delta Debt_{j,t} < 0$, the constructed pressure $WDIT^{QE}_{t,\tau}$ is negative for the tenors into which money funds channel the displaced cash; combined with the positive β estimated below, a larger predicted demand inflow (a more negative $WDIT^{QE}_{t,\tau}$) therefore maps into a larger spread decline. We then map the fund-level bank-side shocks into Treasury-tenor-level pressure using lagged MMF's Treasury portfolio weights, normalized by the tenor's market size for interpretability:

$$WDIT^{QE}_{t,\tau} = \text{QEnd}_t \sum_i \theta^{Bill}_{i,\tau,t-1} B_{i,t}, \tag{21}$$

where $\theta^{Bill}_{i,\tau,t-1}$ denotes fund i's lagged portfolio weight on Treasury securities of tenor τ normalized by market size and QEnd_t is an indicator variable equal to one for quarter-end months and zero otherwise.

The identifying assumption to ensure OLS estimator's consistency is that residual tenor-month pricing shocks are orthogonal to predicted window-dressing pressure after conditioning on fixed effects and controls:

$$\mathbb{E}\left[\epsilon_{t,\tau} WDIT^{QE}_{t,\tau} \mid \alpha_t, \gamma_{\tau,q(t)}, X_{t,\tau}\right] = 0. \tag{22}$$

In Appendix B.4, we show that Assumption 1, if satisfied, implies the orthogonality condition (22) and therefore allows us to recover β.

Assumption 1 *For any Treasury tenor τ and bank j in each period t, the MMF's lagged holding share in tenor τ, $\theta^{Bill}_{i,\tau,t-1}$, times the lagged bank-fund exposure $\theta^{Bank}_{i,j,t-1}$ is orthogonal to*

the unobserved tenor-level price shock $\epsilon_{t,\tau}$:

$$\mathbb{E}_{\tau,j,t}\left[\epsilon_{t,\tau}\theta^{Bill}_{i,\tau,t-1}\theta^{Bank}_{i,j,t-1}\middle|\ \alpha_t,\ \gamma_{\tau,q(t)},\ X_{t,\tau}\right]=0,\quad \forall i,j,\tau,t$$

This identification strategy builds on the insight of Goldsmith-Pinkham et al. (2020) that Bartik instruments can be interpreted as instruments constructed from predetermined exposure shares. In this sense, our approach resembles an exposure design: Treasury bill tenors are exposed to common window-dressing shocks, and the magnitude of that exposure is jointly determined by lagged MMF portfolio allocations and lagged bank-fund relationships (Chaudhary et al., 2023).

To illustrate the intuition, consider a quarter-end at which a bank reduces its borrowing from MMFs by $100 billion. The size of this window-dressing shock may itself be correlated with Treasury bill prices.[10] Suppose the bank has historically obtained 20% of its MMF funding from Fund A and 80% from Fund B, reflecting persistent bank-fund relationships. Under our construction, the bank's reduction in borrowing generates an additional $20 billion of liquidity for Fund A and $80 billion for Fund B that must be reallocated.

Next, suppose each fund mechanically reallocates this liquidity according to its predetermined portfolio weights. For simplicity, assume Fund A allocates half of its assets to Treasury securities and invests exclusively in one-month bills, while Fund B also allocates half of its assets to Treasury securities but invests exclusively in three-month bills. The bank's borrowing reduction therefore generates a $10 billion demand shock to one-month bills and a $40 billion demand shock to three-month bills.

If lagged MMF portfolio weights and lagged bank-fund relationships are orthogonal to contemporaneous shocks to Treasury bill prices, then the relative demand pressure across bill tenors induced by the common bank shock is as good as randomly assigned. This variation provides the identifying source of cross-sectional demand shocks used in our empirical design.

Table 7 reports the baseline estimates of equation (19). The sample includes nominal Treasury bills, notes, and bonds with less than one year remaining maturity.[11] All columns

[10] Some dealer banks may use capital borrowed from MMFs to engage in arbitrage across Treasury securities. Through term-structure linkages, these activities may be correlated with Treasury bill prices.

[11] We exclude securities within 15 days of maturity. Near maturity, small price differences imply large annualized yield swings and trading thins out, making their measured spreads unreliable.

include report-month and year-quarter-by-maturity-bucket fixed effects and control for the bid–ask spread. Column (1) uses the full sample, column (2) uses observations before 2015, and column (3) uses observations from 2015 onward. Across the three samples, the coefficient on $WDIT^{QE}_{t,\tau}$ is positive and statistically significant. Since $WDIT^{QE}_{t,\tau}$ is negative for tenors into which quarter-end window dressing channels money-fund demand (it is built from the bank-debt reduction $\Delta Debt_{j,t} < 0$), a positive coefficient means that tenors with a larger predicted demand inflow experience larger spread declines. In the full sample the coefficient is 4.9, so a predicted demand inflow equal to one percent of a tenor's market size lowers its spread by about 4.9 basis points.

Moreover, the estimate is larger before 2015, at 6.9, than after 2015, at 4.6. Two forces likely drive this result. First, the Federal Reserve's overnight reverse repo (ON RRP) facility expanded over the sample. Before 2015 it was small, so MMFs absorbed withdrawn bank funding mainly in Treasury bills. As its capacity grew (Appendix B.4.5), the ON RRP became a cushion for the reallocation, dampening the impact on Treasury prices. Second, the outstanding stock of Treasury bills grew substantially, so a given amount of MMF demand pressure became a smaller share of a deeper, more elastic market and moved prices less. The larger pre-2015 multiplier is also consistent with the near-zero pre-2015 reduced-form yield effect documented in Appendix B.2.2: before the Basel III disclosure phase-in, the window-dressing shock itself was small, so even a steep demand curve produced little average quarter-end price movement.

Table 7: Window-Dressing Spillovers to Short-Maturity Treasury Spreads

Dependent Variable:	$\Delta spread$		
	Full Sample	2012-2014	2015-2024
Specification:	(1)	(2)	(3)
$WDIT^{QE}$	4.895**	6.870***	4.565**
	(1.919)	(2.349)	(2.200)
Controls	Yes	Yes	Yes
YearQuarter × Maturity bucket	Yes	Yes	Yes
Report month	Yes	Yes	Yes
Observations	1,840	432	1,408
R^2	0.831	0.585	0.833
Within R^2	0.006	0.049	0.005

Notes: OLS estimates of equation (19). The dependent variable is the month-end change in the spread to the federal-funds lower bound, in basis points. The same short-maturity Treasury universe—nominal bills, notes, and bonds with under one year to maturity—is used to construct both $WDIT^{QE}_{t,\tau}$ and $\Delta spread_{t,\tau}$, and securities within 15 days of maturity are excluded. All specifications include report-month and year-quarter-by-maturity-bucket fixed effects and control for the bid–ask spread. Standard errors, clustered by year-quarter-by-maturity bucket, are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

6.1 Unpacking the $WDIT^{QE}$ Regressor

Having presented the benchmark estimates of the price multiplier, we now assess the validity of our identification strategy. We closely follow the diagnostic tests and visualization procedures proposed by Goldsmith-Pinkham et al. (2020).

In our setting, the conventional "industry share" corresponds to the exposure of Treasury bill tenor τ to bank issuer j through fund i, given by

$$\sum_i \theta^{Bill}_{i,\tau,t-1}\theta^{Bank}_{i,j,t-1}.$$

Our sample comprises funds that reallocate capital from the liabilities of 79 banks into Treasury bills, implying that the shift-share regressor is a weighted average of $J = 79$ underlying bank-specific shocks, one for each issuer bank j. The Rotemberg decomposition below operates at the issuer-by-quarter-end-month level, so the underlying components are these issuer-month cells, and Panel D later aggregates them back to the issuer level to rank the most influential banks. Since these banks differ substantially in their contribution to the

aggregate instrument, the overall validity of the identification strategy depends primarily on the plausibility of the identifying assumptions for the most influential banks.

6.1.1 Rotemberg Weights

To formally rank the importance of the individual bank, we perform a Rotemberg decomposition of the regressor outlined in Goldsmith-Pinkham et al. (2020). If any particular instrument is misspecified, the Rotemberg weight tells us how sensitive the overall estimator is to the misspecification of the individual component. To be specific, we can decompose our estimator in the following way [12]:

$$\hat{\beta} = \sum_{t,j} \hat{\alpha}_{t,j} \hat{\beta}_{t,j} \tag{23}$$

where $\sum_{t,j} \hat{\alpha}_{t,j} = 1$ and $\hat{\alpha}_{t,j}$ is the Rotemberg weight. Each $\hat{\beta}_{t,j}$ is the just-identified estimate of the price multiplier, obtained using only bank j's month-t component as the instrument.

We illustrate the Rotemberg decomposition using our benchmark specification, reported in Column (1) of Table 7. Table 8 summarizes the distribution of the resulting Rotemberg weights. Panel A shows that the Rotemberg weights are predominantly positive across banks. Panel B further shows that these weights are strongly negatively correlated (-0.84) with the magnitude of bank-level window dressing. Thus, the banks experiencing the largest quarter-end liability contractions contribute most to identification, making the validity of the identifying assumptions for these banks particularly important. Reassuringly, the component-level estimates $\hat{\beta}_{jt}$ are essentially uncorrelated with both the Rotemberg weights and the size of the underlying shock (Panel B), so the aggregate estimate is not mechanically driven by up-weighting components with a particular $\hat{\beta}$. To assess the sensitivity of our results, we identify the five banks with the largest Rotemberg weights and re-estimate the benchmark specification using each of these banks individually. The corresponding estimates, reported in Panel D, range from 0.3 to 7.7. Because each is identified off a single bank's variation alone, the individual confidence intervals are wide, but the estimates are uniformly positive, and four of the five confidence intervals contain the benchmark estimate of 4.9, consistent

[12] The way to compute the individual weight and the just-identified estimator is shown in the appendix

with the identifying assumptions. Collectively, these five banks account for approximately 68.5% of the total Rotemberg weight. Panel C shows that observations from 2016–2018 contribute the most to identification. Finally, Panel E demonstrates that the overall estimator is driven primarily by observations with positive α values, while observations with negative α values contribute relatively little.

Table 8: Summary of Rotemberg weights

Panel A: Negative and positive issuer-month weights

Sign	Sum	Mean (bp)	Share
Negative	-0.114	-1.184	0.093
Positive	1.114	7.550	0.907

Panel B: Correlations across issuer-month components

	$\hat{\alpha}_{jt}$	$WDIT_{jt}$	$\hat{\beta}_{jt}$	F-stat	$\text{Var}(\theta_{ijt})$
$\hat{\alpha}_{jt}$	1.000				
$WDIT_{jt}$	-0.835	1.000			
$\hat{\beta}_{jt}$	0.004	-0.011	1.000		
F-stat	0.365	-0.355	0.009	1.000	
$\text{Var}(\theta_{ijt})$	-0.121	0.163	0.025	-0.129	1.000

Panel C: Variation across calendar years

Year	Sum $\hat{\alpha}$	Mean $\hat{\alpha}$ (bp)
2012	0.023	1.377
2013	0.047	2.463
2014	0.077	4.058
2015	0.066	3.474
2016	0.220	11.947
2017	0.203	11.402
2018	0.113	5.972
2019	0.061	2.929
2020	0.100	4.926
2021	0.059	3.068
2022	0.009	0.491
2023	0.009	0.507
2024	0.012	0.637

Panel D: Top five positive issuer-level Rotemberg weights

Issuer	$\hat{\alpha}_j$	$WDIT_{jt}$	$\hat{\beta}_j$	95% CI	$\hat{\beta}$ contribution	F-stat
Credit Agricole	0.253	-31.746	6.856	(2.30, 11.60)	1.734	571.927
BNP Paribas	0.147	-15.061	0.296	(-4.10, 4.60)	0.043	268.858
Societe Generale	0.123	-22.054	3.882	(0.60, 7.20)	0.478	388.627
Barclays PLC	0.101	-19.858	7.696	(1.30, 14.10)	0.776	364.026
Credit Suisse	0.061	-6.418	2.756	(-2.00, 7.70)	0.168	400.443

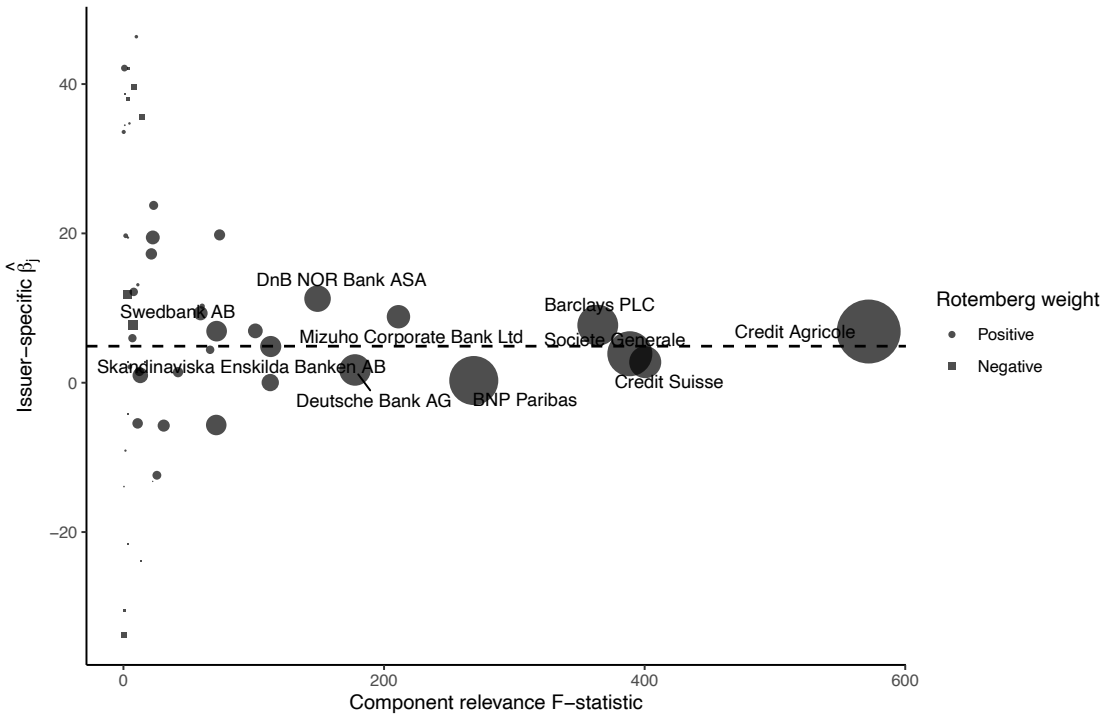
Panel E: Component estimates for positive and negative weights

Sign	$\hat{\alpha}$-weighted sum	Share of overall $\hat{\beta}$	Mean $\hat{\beta}_{jt}$
Negative	-1.457	-0.298	51.056
Positive	6.352	1.298	-118.416

Notes: Panels A–C and E use issuer-by-quarter-end-month components. Mean Rotemberg weights in Panels A and C are multiplied by 10,000 and reported in basis points of weight. Panel A's Share is the group's share of total Rotemberg-weight mass. In Panel B, the F-statistic is the squared clustered t statistic from the auxiliary relevance regression of aggregate WDIT on the issuer-month WDIT component, using the equation (19) controls and fixed effects. It is not a substantive first stage for equation (19). $\text{Var}_i(\theta_{ijt})$ is the sample variance across active funds of $\theta_{ijt} = Value_{ij,t-1}/Value_{j,t-1}$; active funds with no exposure to issuer j are assigned zero. Panel D first aggregates across months within issuer and reports the five largest positive issuer weights. Its confidence set inverts clustered tests of a zero coefficient on the issuer-specific component in a regression of $\Delta spread - bWDIT^{QE}$ on that component, the bid–ask control, report-month fixed effects, and tenor-by-quarter fixed effects. The search grid is $[-20, 20]$ with step 0.100. The aggregate equation (19) estimate is $\hat{\beta} = 4.895$. In Panel E, the $\hat{\alpha}$-weighted sums are the identification-relevant quantities and reconcile to $\hat{\beta} = 4.895$. The unweighted Mean $\hat{\beta}_{jt}$ in the last column is reported only for completeness. An individual issuer-month estimate $\hat{\beta}_{jt}$ becomes very large in either sign whenever that component's residualized exposure to the aggregate instrument is close to zero, so this raw mean is driven by a handful of such issuer-months rather than being informative.

Figure 5 visualizes the relationship among the Rotemberg weights associated with each bank j, the relative contribution to the overall estimator, and the just-identified estimator $\hat{\beta}_j$.

Figure 5: Rotemberg Weights, F-statistic and $\hat{\beta}_j$



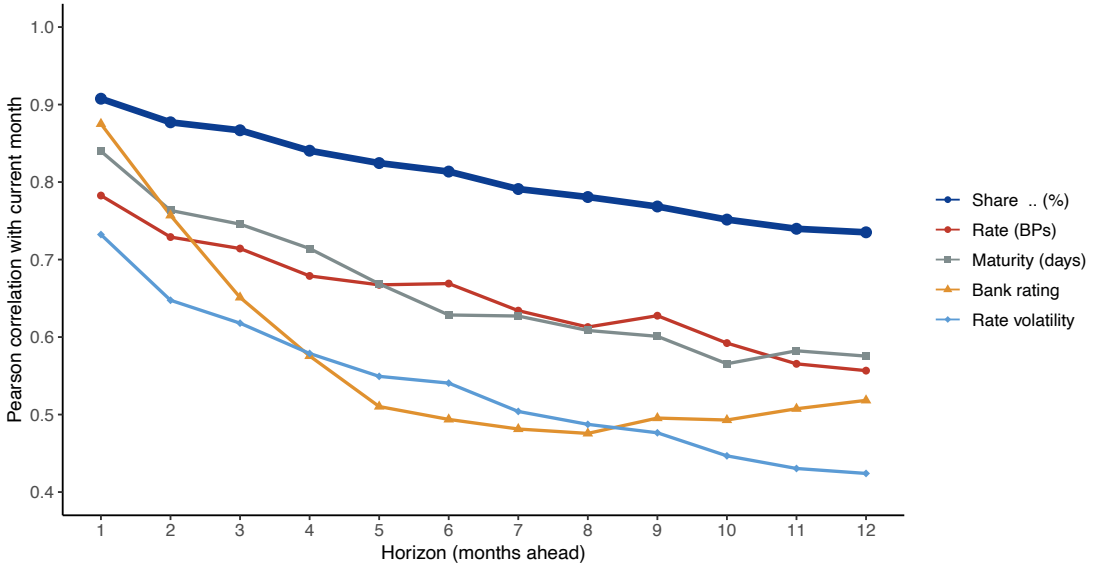
Notes: This figure illustrates the relationship between the Rotemberg weight, the F-statistic, and the bank-specific estimator $\hat{\beta}_j$. Marker size is proportional to the magnitude of the corresponding $\hat{\alpha}_j$. Squares denote negative Rotemberg weights, while circles denote positive Rotemberg weights. The dashed horizontal line indicates the benchmark market-level estimate. The ten banks with the largest Rotemberg weights are labelled correspondingly.

6.2 Exogenous Shares

To assess whether shares are conditionally exogenous, we start by claiming that the exposure shares $\theta_{i,j,t}^{Bank}$ capture stable fund–bank relationships. Figure 6 shows that the shares $\theta_{i,j,t}^{Bank}$ are highly persistent: the one-month autocorrelation is about 0.91, and the six-month autocorrelation remains about 0.81. More importantly, the share is far more persistent than the observable fundamentals that would drive a reallocating investor: the funding rate, its volatility, the position's maturity, and the bank's credit rating all decay markedly faster, as

the figure shows. This persistence supports the interpretation of $\theta^{Bank}_{i,j,t}$ as a predetermined relationship exposure rather than a tactical portfolio adjustment around quarter-end. At the extensive margin, Figure B.16 in the appendix further shows that, once a fund–bank relationship is established, 85% of relationships remain active one year later.

Figure 6: Autocorrelation of $\theta^{Bank}_{i,j,t}$ and Its Drivers



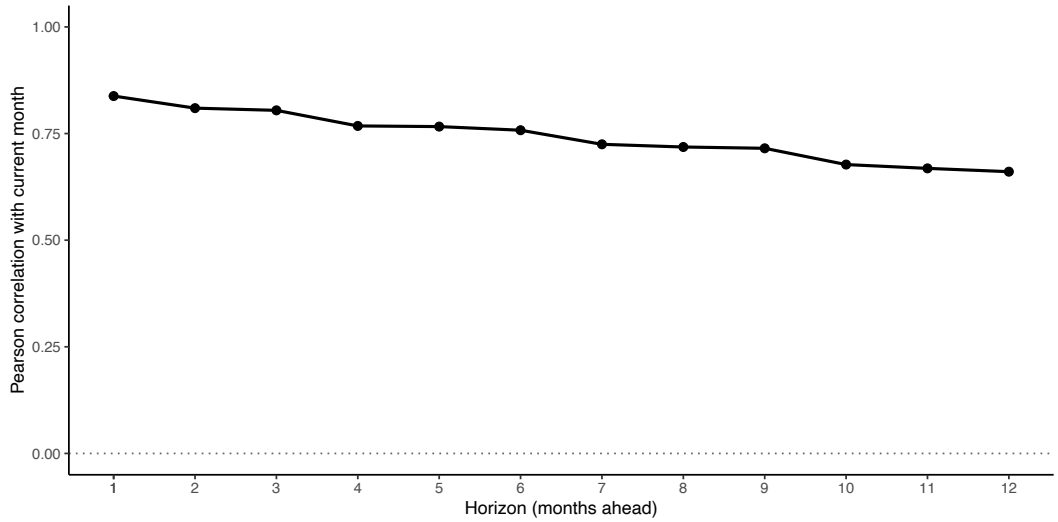
Notes: This figure plots the pooled Pearson autocorrelation of the fund–bank funding share $\theta^{Bank}_{i,j,t}$ (dark blue) at horizons of $x = 1, \ldots, 12$ months, together with the autocorrelation of the observable fundamentals of the same fund–bank position: the value-weighted funding rate over EFFR (Rate, in bps), the within-position dispersion of security spreads (Rate volatility), the value-weighted days-to-maturity (Maturity), and the value-weighted numeric Moody's rating (Bank rating). Each series is the pooled correlation of the pair-month value with its value x months later. The share is markedly more persistent than any of its drivers at every horizon. The x-axis measures the horizon in months.

The persistence of these relationships is also consistent with the institutional features of the MMF industry. Since the Global Financial Crisis, MMFs have increasingly prioritized capital preservation, liquidity, and regulatory compliance over yield maximization. Successive reforms have tightened liquidity, credit quality, and maturity requirements, reinforcing incentives for funds to maintain stable funding and trading relationships rather than continuously search for marginal yield differentials. In this environment, relationship-based intermediation is a natural outcome. Our findings are consistent with the evidence in Huber (2023), who shows that MMFs often transact simultaneously at different repo rates rather

than exclusively supplying funds to the highest-yielding counterparty, even after conditioning on issuer risk.

What about MMFs' Treasury investment decisions? The lagged portfolio weights $\theta^{Bill}_{i,\tau,t-1}$ are the second key component of our identification strategy. These weights are measured prior to the quarter-end window and therefore predate the Treasury-market price movements that we seek to explain. Repeating the same persistence exercise reveals that Treasury-tenor allocations are also highly stable over time, as shown in Figure 7. This evidence supports the interpretation of $\theta^{Bill}_{i,\tau,t-1}$ as predetermined portfolio exposures rather than active responses to quarter-end price fluctuations.

Figure 7: Autocorrelation of $\theta^{Bill}_{i,\tau,t}$



Notes: This figure plots the autocorrelation of $\theta^{Bill}_{i,\tau,t}$ measured in percentage points. The x-axis measures the time lags.

A natural follow-up question is what determines a fund's allocation across Treasury bill tenors. Beyond idiosyncratic fund preferences, a primary determinant is duration management under the prevailing interest-rate environment. As illustrated in Figure B.17, when interest rates are rising, MMFs have incentives to shorten portfolio maturity in order to preserve reinvestment flexibility and reduce interest-rate risk. Conversely, when rates are expected to decline, funds may modestly extend maturity to lock in prevailing yields. Beyond the first moment, i.e. increasing or decreasing interest rate, Abdullah and Tase (2025)

finds the second moment of the policy rate also matters. More specifically, they use survey data to measure policy rate uncertainty and find MMFs tend to lower their overall portfolio duration by investing in shorter Treasuries when facing higher uncertainty. For our analysis, these duration-management considerations are driven by aggregate interest-rate conditions that are common across funds and bill tenors. Our empirical specification absorbs such common forces through month-end fixed effects and tenor-by-quarter fixed effects. Consequently, identification does not rely on variation generated by changing interest-rate expectations. Instead, conditional on these fixed effects and other controls, the lagged tenor weights provide a predetermined mapping that translates fund-level bank-funding shocks into predicted Treasury-bill demand pressure across tenors.

Finally, to examine whether the two layers of predetermined exposures are systematically related to observable fund characteristics, we regress the bank–tenor exposure share $\sum_i \theta^{Bill}_{i,\tau,t-1}\theta^{Bank}_{i,j,t-1}$ on fund characteristics. Since the available characteristics are observed at the fund–time level, they must first be aggregated to the tenor level so that the analysis is conducted at the same regression-cell level as equation (19). Specifically, we construct tenor-level characteristics by weighting each fund's characteristic with its lagged Treasury portfolio share:

$$\bar{X}_{t-1,\tau} = \frac{\sum_i \theta^{Bill}_{i,\tau,t-1} X_{i,t-1}}{\sum_i \theta^{Bill}_{i,\tau,t-1}}. \tag{24}$$

Following Goldsmith-Pinkham et al. (2020), we then regress the bank–tenor exposure share for each of the five banks with the largest Rotemberg weights on these mapped characteristics. Table 9 reports the results. Overall, we find little evidence that observable fund characteristics systematically explain the bank–tenor exposure shares. While a small number of coefficients are statistically significant, these estimates are economically small, do not exhibit a consistent sign across banks, and are not robust across specifications. In particular, characteristics such as cash holdings, portfolio yield, maturity, liquidity, fund size, and investor flows fail to display stable relationships with the exposure shares of the five banks that receive the largest Rotemberg weights. Moreover, when the dependent variable is the aggregate predicted demand measure (Aggregate WDIT), none of the characteristics is sta-

tistically significant. These findings suggest that the identifying variation in our shift-share instrument is not driven by observable fund characteristics, providing additional support for the exogeneity of the predetermined exposure shares underlying our empirical design.

Table 9: Relationship between Shares and Fund Characteristics

	(1) Credit Agricole	(2) BNP Paribas	(3) Societe Generale	(4) Barclays PLC	(5) Credit Suisse	(6) Aggregate WDIT
Cash / AUM (pp)	0.0001	0.0001*	0.0001**	0.0000	0.0000	-0.0025
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0000)	(0.0051)
Seven-day gross yield (pp)	0.0106	0.0066	0.0090	0.0044	0.0048	-0.6784
	(0.0068)	(0.0060)	(0.0062)	(0.0057)	(0.0053)	(0.5811)
WAM (days)	-0.0001	-0.0001*	-0.0001	-0.0001**	-0.0001*	0.0015
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0061)
Daily liquid assets / AUM (pp)	0.0000	-0.0001***	0.0000**	0.0000	0.0000	0.0023
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0028)
Log(min investment threshold)	0.0001	0.0002	0.0000	-0.0001	0.0000	-0.0024
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0098)
Log (AUM)	0.0004	0.0013***	0.0006	0.0007*	0.0002	0.0012
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0343)
Net flow / AUM (pp)	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0032
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0021)
Time	Yes	Yes	Yes	Yes	Yes	Yes
Tenor	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.70844	0.70012	0.67731	0.60640	0.70246	0.79429
Observations	255	255	255	255	255	255

Notes: Each column reports regression results of the pre-quarter-end bank–tenor exposure share on fund characteristics for the five banks with the largest Rotemberg weights. All fund characteristics are mapped to the tenor level following equation 24. Cash is the total cash holdings of the fund. Seven-day gross yield is the annualized seven-day gross yield offered to shareholders. WAM is the weighted-average maturity of the fund's overall portfolio. Daily liquid assets are defined according to SEC Rule 2a-7. Minimum investment threshold is the minimum initial investment required by the fund. Net flow is the monthly net capital flow into the fund.

The baseline specification measures both exposure shares one month before the quarter-end window. Table 10 re-estimates the full-sample spillover coefficient using fund–bank exposure shares lagged $k_1 \in \{3, 6, 12\}$ months and Treasury tenor weights lagged $k_2 \in \{3, 6, 12\}$ months, while continuing to measure the ΔDebt shocks over the one-month window. The coefficient on $WDIT^{QE}$ remains positive and statistically significant at the 1% level across all nine lag combinations, and every estimate exceeds the one-month baseline estimate of 4.9. The point estimates increase with the lag length, ranging from approximately 5.0 when both exposure shares are lagged three months to approximately 9.5 when both are lagged twelve months. These results indicate that the estimated spillover is not broadly driven by the particular choice of lag structure. If anything, measuring exposure shares further in advance—thereby making them more clearly predetermined—strengthens the estimated price impact, suggesting that the baseline specification is conservative.

Table B.15 reports a complementary placebo exercise in which the quarter-end indicator is shifted one month earlier while leaving the predetermined exposure shares unchanged. Under this falsification test, the estimated coefficients are uniformly small and statistically insignificant. The absence of any placebo effect suggests that the identifying variation is specific to the actual quarter-end demand reallocation rather than reflecting spurious seasonality or persistent differences across tenors.

Table 10: Lag Robustness: $WDIT^{QE}$ Coefficient across Share-Lag Combinations

	Treasury weight lag k_2		
Fund–bank share lag k_1	3 months	6 months	12 months
3 months	5.016***	6.023***	7.229***
	(1.635)	(1.805)	(1.818)
6 months	6.224***	6.716***	8.355***
	(1.704)	(1.943)	(1.893)
12 months	6.810***	6.629***	9.538***
	(1.925)	(2.011)	(2.177)

Notes: Each cell re-estimates the full-sample baseline (Table 7, column 1; $N = 1{,}840$ throughout), replacing the one-month lags in $WDIT^{QE}$ with k_1-month fund–bank exposure shares and k_2-month Treasury tenor weights; the ΔDebt shocks remain at lag one. All specifications include year-quarter-by-maturity-bucket and report-month fixed effects. Standard errors, clustered by year-quarter-by-maturity bucket, are in parentheses. *** **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Finally, Appendix B.4.7 shows that our results are robust to a weaker identification assumption, which requires exogeneity only of the predetermined fund–bank relationships. The resulting estimates are quantitatively very similar to our benchmark specification. In Appendix B.4, we further compare the predicted demand pressure, $WDIT^{QE}_{t,\tau}$, with the realized quarter-end portfolio reallocation, $\Delta Bill^{QE}_{t,\tau}$, and document a close correspondence between the two measures. Finally, Figure B.20 benchmarks our estimated price impact against comparable estimates in the existing literature, placing our results in the context of the broader evidence on institutional demand elasticities.

7 Policy Implications: The Fiscal Cost of Bill-Heavy Funding

The U.S. Treasury has financed a growing share of the federal debt at the front end of the yield curve. It has held long-dated Treasury auction sizes roughly constant, to contain long-term yields, and routed incremental funding needs into bills, so that bills now stand at roughly 22% of marketable debt, above the 15–20% range suggested by the Treasury Borrowing Advisory Committee. The Congressional Budget Office projects about $26 trillion of additional federal net borrowing between 2026 and 2036; holding the bill share constant at 22% implies about $5.7 trillion of net new bill issuance over the eleven years, roughly doubling the bill stock. If Treasury bill demand were perfectly elastic, this tilt would be nearly costless. Our estimate says it is not. This section asks two questions: (i) how much could the Treasury save by timing bill auctions to the quarter-end window, and (ii) what do our estimates imply for future bill funding costs under alternative issuance scenarios?

7.1 Time the Bill Issuance to the Quarter-End Window

Because the quarter-end demand pressure is *predictable*, it raises a sharper debt-management question: can the Treasury lower its funding cost by simply concentrating bill issuance in the quarter-end window, when MMF demand is strongest and front-end yields are most depressed?

Our regression estimates imply that T-bill yields are *lower* at quarter-end relative to the federal funds rate by 5.65 basis points in the 0–3 month maturity bucket, 3.59 bp in the 3–6 month bucket, and 3.44 bp in the 6–12 month bucket[13]—an issuance-weighted average of 5.03 bp across the standard bill tenors. From the Treasury's perspective, issuing when yields are depressed lowers funding costs.

We quantify this timing strategy using the full Treasury auction record (TreasuryDirect, 1979–2025), restricting to our sample period 2012–2024 and to the standard tenors (4-, 8-, 13-, 26-, and 52-week bills). We define the quarter-end window as the last two weeks of

[13]The 6–12 month coefficient is statistically insignificant in the bills-only sample (Table 1, Panel A); we use the point estimate here. The issuance-weighted average is in any case dominated by the shorter tenors, whose estimates are precisely measured.

March, June, September, and December—the period over which the event-study evidence in Section 3 shows the strongest MMF-driven yield compression. Over the sample, about 17% of gross bill issuance (by offering amount) fell inside this window each year, with an average maturity of 104 days across all tenors issued at quarter-end.

The counterfactual we consider is: what would the Treasury have saved if, within each year of the sample, it had shifted all non-quarter-end issuance into the quarter-end window? The saving per dollar issued depends on both the maturity bucket (which determines the regression-estimated yield advantage) and the specific tenor of the bill (which determines how many days that advantage accrues). Concretely, for a bill of tenor τ days issued in bucket b, the saving per dollar is approximately[14]

$$s_{b,\tau} = \frac{|\hat{\beta}^{b}_{\text{QEnd}}|}{10{,}000} \times \frac{\tau}{365},$$

so a 4-week bill in the 0–3 month bucket saves $5.65\,\text{bp} \times (28/365) = 0.0043\%$ of face value, while a 52-week bill in the 6–12 month bucket saves $3.44\,\text{bp} \times (364/365) = 0.034\%$. We apply term-specific saving rates to every individual auction record and sum across all non-quarter-end auctions within each calendar year. The issuance-weighted average saving rate across all non-quarter-end auctions is 0.012% of face value. Summing over all non-quarter-end auctions in the sample gives an upper-bound estimate of the forgone saving.

The results are reported year by year in Table 11. Non-quarter-end gross issuance grew from roughly $4.4 trillion in 2012 to $14.3 trillion in 2024, reflecting the rapid expansion of the bill stock. The implied upper-bound saving follows a similar path, rising from $578 million in 2012 to $1.7 billion in 2024, with a sample average of about $860 million per year and a cumulative total of $11.2 billion over the thirteen years.

Two forces limit the timing channel relative to the volume channel studied next. First, the quarter-end window is short—eight weeks per year—so concentrating substantially more issuance into it would require much larger individual auctions, which may itself attenuate the yield advantage the Treasury is trying to harvest. Second, the timing benefit operates on the *flow* of gross issuance, saving a few basis points on each bill over its sub-year life,

[14] A derivation is provided in Appendix B.5.

whereas the supply-pressure cost in Section 7.2 operates on the *stock* of outstanding bills. Even at $860 million per year, the timing saving is an order of magnitude smaller than the first-year supply-pressure cost under the base scenario of Section 7.2. We therefore present the timing channel as an illustration of the mechanism's debt-management relevance, not as a material offset to the volume-driven fiscal cost.

Table 11: Within-Sample Counterfactual: Shifting Issuance to the Quarter-End Window

Year	Total issuance ($bn)	Non-QEnd ($bn)	QEnd share	Saving ($mn)
2012	5,255	4,432	15.7%	577.6
2013	5,461	4,550	16.7%	570.8
2014	4,662	3,716	20.3%	479.8
2015	4,616	3,690	20.1%	463.4
2016	6,131	5,142	16.1%	619.6
2017	6,236	5,229	16.1%	651.8
2018	7,897	6,624	16.1%	834.5
2019	8,874	7,343	17.3%	858.3
2020	10,470	8,631	17.6%	1044.2
2021	9,326	7,603	18.5%	1014.7
2022	10,145	8,343	17.8%	1049.4
2023	13,787	11,365	17.6%	1350.3
2024	17,107	14,284	16.5%	1660.8
Total (2012–2024)	109,967	90,952		11175.1
Average per year				859.6

Notes: Annual T-bill gross issuance (4-, 8-, 13-, 26-, and 52-week bills) from TreasuryDirect, 2012–2024. Quarter-end window defined as the last two weeks of March, June, September, and December. The counterfactual saving for each auction equals $|\hat{\beta}^{b}_{\text{QEnd}}|/10{,}000 \times (\tau/365) \times$ face value, where b is the maturity bucket (0–3m, 3–6m, 6–12m) and τ is the bill's tenor in days (28, 56, 91, 182, or 364). This correctly accounts for how many days of the yield advantage each bill accrues. The issuance-weighted average saving rate across non-quarter-end auctions is 0.012% of face value. This is a partial-equilibrium upper bound: concentrating additional supply in the quarter-end window would itself attenuate the yield advantage.

7.2 Fiscal Cost with Inelastic Bill Market

To quantify the price impact of additional bill supply going forward, we use the following equation[15]:

$$\widehat{\Delta r_\tau^T}^{\text{Supply}} = \hat{\lambda} \times 100 \times \frac{\Delta T_\tau}{\text{Size}_\tau},$$

where $\hat{\lambda}$ is the local price multiplier estimated in Section 6 ($\hat{\lambda} = 4.9$ basis points per percentage point of market size; Table 7), and the factor of 100 expresses the supply increment $\Delta T_\tau/\text{Size}_\tau$ in percentage points of the outstanding stock.

The remaining inputs come from public debt-management sources: a cumulative net increase in federal debt of \$26 trillion over FY2026–2036 (CBO baseline), a bill share of 22%, and a current bill stock of \$6.6 trillion. Holding the bill share at 22% implies about \$5.7 trillion of net new bills over the eleven years from 2026 to 2036. We treat bills as a single market, abstracting from tenor, and phase this increment in at two frequencies that mirror the auction calendar: a weekly increment (most bill tenors auction weekly) and a monthly increment (the 52-week bill auctions roughly monthly). In each case the spread effect accumulates as the stock grows, so the cumulative cost builds over the horizon.

Weekly increment. Spreading \$5.7 trillion evenly over the $11 \times 52 = 572$ weeks of the horizon, the bill stock rises by about \$10 billion each week. Relative to the \$6.6 trillion current stock, each weekly increment is a supply pressure of 0.15 percentage points, which at $\hat{\lambda} = 4.9$ bp/pp lifts the bill spread by about 0.74 basis points per week, roughly \$0.5 billion of additional interest from a single week's issuance. The level effect accumulates: by the end of the first year the spread is about 38 basis points higher, raising annual interest expense by roughly \$27 billion; by the end of 2036 the cumulative spread increase reaches about 423 basis points and the additional annual interest expense is about \$520 billion.

Monthly increment. Spreading \$5.7 trillion evenly over the $11 \times 12 = 132$ months of the horizon, the bill stock rises by about \$43 billion each month, a supply pressure of 0.65

[15] In Appendix B.5, we show that in our model a negative demand shock is equivalent to a positive supply shock in equilibrium.

percentage points per month and a spread increase of about 3.2 basis points per month, roughly $2.1 billion of additional interest from a single month's issuance. By the end of the first year the spread is about 38 basis points higher (about $27 billion of additional annual interest), rising to about 423 basis points and $520 billion per year by 2036.

Table 12: The Fiscal Cost of Bill-Heavy Funding ($\hat{\lambda} = 4.9$ bp/pp)

	Weekly increment	Monthly increment
New bills per period	$9.97 bn	$43.18 bn
Supply pressure per period	0.151 pp	0.654 pp
Spread increase per period	0.740 bp	3.206 bp
First-period extra interest	$0.49 bn	$2.12 bn
First-year spread increase	38.47 bp	38.47 bp
Cumulated first-year extra interest	$13.6 bn	$14.5 bn
Cumulative spread by 2036	423.2 bp	423.2 bp
Cumulative extra interest, 2026–2036	$2,426 bn	$2,443 bn

Notes: Front-end funding-cost increase implied by $5.7 trillion of net new bills over 2026–2036 (the CBO deficit baseline times the 22% bill share), phased in evenly at a weekly or monthly frequency and applied to the current $6.6 trillion bill stock, using the local price multiplier $\hat{\lambda} = 4.9$ bp/pp from Table 7. Bills are treated as a single market. Annualized rows apply the spread reached at the end of the window to the stock for a full year; cumulated rows sum the interest actually accrued as the spread and stock build up over the window. All figures scale linearly in $\hat{\lambda}$.

The cumulated figure adds up the interest actually paid as the spread ramps up from zero. In each period k the spread has grown to $k\,\Delta s$, and it applies to the stock outstanding at that point, $S_0 + k\,\Delta B$. Here Δs is the per-period spread increment, ΔB the per-period bill increment, and S_0 the initial bill stock. Summing over a window of N periods and converting each annualized spread to a per-period payment gives

$$\text{Cumulated}_N \;=\; \frac{1}{K_{\text{yr}}}\,\frac{1}{10{,}000}\sum_{k=1}^{N} \underbrace{k\,\Delta s}_{\text{spread}_k}\;\underbrace{\big(S_0 + k\,\Delta B\big)}_{\text{stock}_k},$$

where $K_{\text{yr}} = 52$ under the weekly cadence and 12 under the monthly cadence, and the factor $1/K_{\text{yr}}$ converts the annualized spread into the interest paid in a single period.

Over the first year, with $N = K_{\text{yr}}$, the cumulated extra interest is about $13.6 billion

under the weekly cadence and $14.5 billion under the monthly cadence. Summed over the full horizon, 572 weeks or 132 months, the cumulative extra interest through the end of 2036 is about $2.43 trillion under either cadence.

The spread path itself is invariant to the issuance cadence, because the price effect is linear in cumulative supply. The end-of-year spread is about 38 basis points and the 2036 spread about 423 basis points under either schedule. The cumulated totals differ only slightly across cadences, $13.6 versus $14.5 billion in the first year and $2,426 versus $2,443 billion by 2036, because a coarser step front-loads marginally more stock into each accrual. This is a second-order effect of the step size and leaves the headline magnitudes unchanged. They remain economically large: at the estimated multiplier the bill-heavy tilt accrues on the order of $14 billion of extra interest in the first year and about $2.4 trillion cumulatively by 2036.

We stress the *upper-bound* nature of the base calibration. It holds the residual demand curve fixed at its currently estimated position and applies a locally identified slope to a supply shock orders of magnitude larger than the quarter-end variation from which the slope is estimated. Table 13 explores how sensitive the cost is to alternative assumptions about who absorbs the new supply and how that capacity grows over time.

The three scenarios differ in MMF behavior and in the absorptive capacity of residual investors. All scenario paths are computed on the same monthly accrual grid as the monthly-increment column of Table 12: the bill stock grows by about $43 billion per month, the spread accumulates month by month, and each month accrues one-twelfth of a year of interest. *Scenario 1* is the benchmark from Table 12: the residual demand curve is held fixed at its current position, so the full $\hat{\lambda} = 4.9$ bp/pp applies to the entire new supply. *Scenario 2* assumes that MMF Treasury holdings remain frozen at their current level (approximately $2.75 trillion at end-2024 in the N-MFP data, which we round to $3 trillion as the assumed level at the start of the 2026 projection horizon) and that all new supply must be absorbed by non-MMF residual investors, whose capacity grows in proportion to nominal GDP using the CBO's January 2025 projections for 2026–2036. As the economy expands, residual investors can absorb more bills without requiring as large a yield concession, so the per-dollar supply pressure falls steadily and the cumulative cost declines to roughly $2.2 trillion, moderately

below the base case, with GDP growth as the only mitigating force. *Scenario 3* additionally allows MMF Treasury holdings to grow from the same $3 trillion base at their historical rate. We consider three growth rates that bracket the historical experience: 5%, 10%, and 20% per year. MMF absorption in year t is $\Delta_t^{\text{MMF}} = M_0\, g(1+g)^{t-1}$, and the residual absorption is $\max(0,\, \Delta B - \Delta_t^{\text{MMF}})$, which generates the residual supply pressure that the GDP-scaled demand curve must clear.

Table 13: Fiscal Cost Under Alternative Absorption Scenarios

	S1: Base	S2: MMF frozen	S3: Low (5%)	S3: Mid (10%)	S3: High (20%)
First year (2026):					
Cumulative spread (bp)	38.47	38.47	27.33	16.20	0.00
Extra annual interest ($bn)	27.4	27.4	19.5	11.5	0.0
Cumul. extra interest ($bn)	14.5	14.5	10.3	6.1	0.0
2036 (end of horizon):					
Cumulative spread (bp)	423.2	354.3	224.2	55.4	0.0
Extra annual interest ($bn)	520.5	435.8	275.7	68.1	0.0
Cumul. extra interest 2026–2036 ($bn)	2442	2165	1429	492	0

Notes: All scenarios use $\hat{\lambda} = 4.9$ bp/pp and a current bill stock of $6.6 trillion, and are phased in and accrued on the same monthly grid as the monthly-increment column of Table 12, whose figures Scenario 1 reproduces. Scenario 1 (base) is Table 12: the residual demand curve is fixed. Scenario 2 freezes MMF Treasury holdings at $3 trillion, the end-2024 N-MFP level of $2.75 trillion rounded up to the assumed 2026 starting level; residual absorptive capacity grows proportionally with CBO Jan-2025 nominal GDP projections. Scenario 3 (low/mid/high) additionally allows MMF Treasury holdings to grow at 5%/10%/20% per year from the same $3 trillion base; for reference, the historical CAGR of MMF Treasury holdings was 5.5% over 2020–2024 and 20.8% over 2015–2019. At 20%/yr MMF growth absorbs all new supply from the first year, leaving zero residual pressure. Annual interest figures are the annualized cost at the spread reached by the end of each year; cumulative figures sum accrued interest over 2026–2036.

At a 10% annual MMF growth rate the cumulative extra interest falls to about $490 billion, roughly one-fifth of the base-case figure, because growing MMF demand absorbs the majority of new supply before it reaches the residual curve. At 20% growth MMFs would absorb all projected new supply from year one, eliminating the additional supply pressure entirely. Conversely, if MMF holdings stagnate and the residual investor base merely keeps pace with GDP (Scenario 2), the saving relative to the base is modest: about $280 billion, or 11%, over the horizon. The base case is therefore less sensitive to MMF growth than to the slope of residual demand, and the headline $2.4 trillion figure should be understood as the cost that obtains when neither channel provides relief.

8 Conclusion

This paper documents a recurring quarter-end anomaly at the front end of the U.S. Treasury curve. Using daily security-level Treasury prices from 2012 to 2024, we show that yields on securities with less than one year to maturity fall systematically on quarter-end days. The effect is largest at the shortest maturities, roughly 3 to 9 basis points, and remains after security, market, and policy controls.

We attribute this pattern to portfolio reallocation induced by bank balance-sheet window dressing. At quarter-end, foreign banks reduce short-term borrowing from money market funds, especially in repo and unsecured markets. Money funds then redirect displaced cash toward government money-like assets, primarily Treasury bills and the Federal Reserve's overnight reverse repurchase facility.

We connect this channel directly to Treasury prices using a design that maps bank-level funding contractions into predicted demand pressure across bill tenors. Tenors exposed to larger predicted demand pressure experience larger quarter-end yield declines, with an estimated local price multiplier of about 4.9 basis points per percentage point of demand pressure.

The results show that predictable price pressure can persist even in the market for short-term U.S. government debt when balance-sheet and mandate constraints bind simultaneously. They also show that bank regulation can spill over into government debt pricing through the portfolio choices of near-money investors. As Treasury bill issuance grows, these effects may become more fiscally relevant: the estimated multiplier implies that greater reliance on bills can raise funding costs when front-end demand is inelastic. Treasury bill yields are therefore not only market benchmarks, but equilibrium outcomes shaped by regulation, institutional mandates, and disclosure timing.

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A Theory Appendix

A.1 Discussion of Modeling Choices

First, we do not distinguish between different types of bank debt used between banks and money market funds. In practice, both unsecured instruments—such as commercial paper, certificates of deposit, and time deposits—and secured instruments, such as repos, are widely used. We provide a detailed breakdown in the empirical section. Since the equilibrium implications are qualitatively identical across these instruments, we abstract from this distinction for simplicity [16].

Second, we do not explicitly model single-issuer exposure constraints for bank debt according to SEC 2a-7 rule. A simple extension would introduce a penalty term into equation (5), such that money funds effectively receive $r^B_{i,t} - r^c$, where r^c represents the shadow cost of the exposure constraint. However, since all propositions and conclusions remain unchanged relative to the benchmark, we omit this feature for better tractability.

Third, in reality, money market funds allocate a substantial share of their portfolios to the Federal Reserve's reverse repo facility (RRP), which offers an exogenously set rate. The model can be extended by modifying the fund's outside option in (5) to $\max(r^T_t, r^{RRP}_t)$, where r^{RRP}_t tracks the lower bound of the policy rate. However, this modification alone would imply corner solutions—full allocation to either Treasuries or RRP—which is inconsistent with the data. Empirically, allocations vary with the monetary policy regime (see Figure B.17). The intuition is straightforward: the RRP is an overnight instrument with effectively zero duration, whereas Treasuries have longer duration. In a rising rate environment, funds prefer RRP to benefit from higher reinvestment rates; in a declining rate environment, longer-duration Treasuries become more attractive. Since the current model abstracts from duration, capturing this margin would require additional structure. Nevertheless, the main results remain unaffected, so we abstract from this extension.

Fourth, the model does not distinguish between U.S. and non-U.S. banks. While the model matches aggregate empirical patterns—namely $R_1 > R_0$, $r^B_1 > r^B_0$, and $m_1 < m_0$—the data show that most of the reduction in bank borrowing at quarter-end is driven by

[16] Empirical equilibrium rates can be found in Figure B.2

non-U.S. banks. A detailed decomposition in the data is provided in Section 5.

Fifth, the parameter η can be interpreted from two perspectives. (i) Even within Treasury markets, arbitrageurs face multiple trading strategies—such as covered interest parity (CIP), TIPS–Treasury arbitrage, Treasury spot–futures basis trades, and Treasury–swap spreads (see Siriwardane et al., 2025). Substitution across these opportunities is imperfect, limiting arbitrage capacity in any single strategy. (ii) Quarter-end arbitrage resembles a timing strategy rather than a pure long–short trade, and thus requires balance sheet usage, as emphasized in recent work (Chaudhary et al., 2026). Therefore, η can also be interpreted as capturing the cost of balance sheet capacity. Both perspectives are correlated with the inter-dealer funding market situation, hence it's a function of R_1.

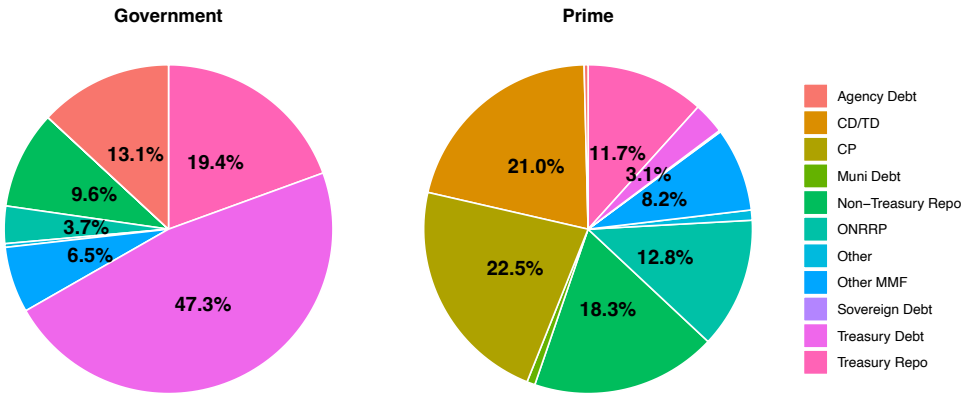
Finally, we abstract from the precise market structure governing bargaining between money funds and banks. The literature has not reached consensus on which side holds market power. For example, Huber (2023) argues that primary dealers price-discriminate across funds, suggesting borrower-side market power, while Doerr and Eren (2025) finds evidence consistent with lender-side power. Our model is agnostic about pricing power in normal periods, but it departs from perfect competition at quarter-end. Under a Walrasian benchmark, window dressing would reduce borrowing demand, implying a lower equilibrium repo rate. In contrast, the data show that repo rates increase at quarter-end, indicating the presence of imperfect competition, see Figure B.2.

B Empirical Appendix

B.1 Empirical Support for the Model Assumptions

Consistent with the model's portfolio choice between lending to banks and holding Treasuries, Figure B.1 shows the composition of holdings by fund type. Government funds hold predominantly Treasury debt (about 47%) and Treasury repo (19%), alongside agency debt (13%) and non-Treasury repo (10%). Prime funds tilt toward bank claims—CD/TD (21%), commercial paper (23%), and Treasury repo (12%)—with only about 3% in Treasury debt.

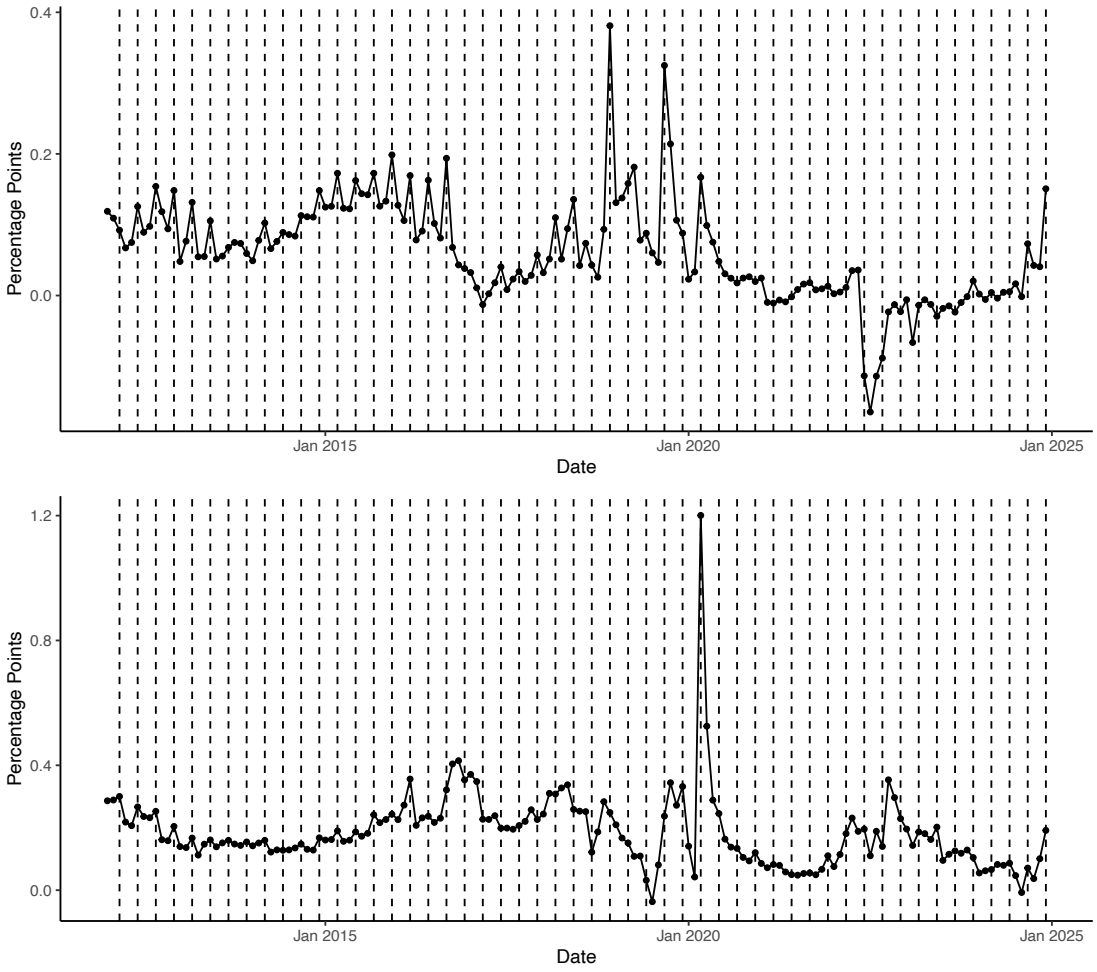
Figure B.1: MMF Holdings by Fund Type



Notes: This figure shows the composition of MMF holdings by fund type as of December 2024. Agency debt refers to debt issued by U.S. agency institutions and government-sponsored enterprises, such as Freddie Mac and Fannie Mae. CD/TD denotes certificates of deposit and time deposits. CP denotes commercial paper. Municipal debt refers to bonds and notes issued by municipalities or related public-sector entities. Sovereign debt refers to U.S. dollar-denominated government debt issued by non-U.S. governments. Treasury repo refers to repurchase agreements collateralized by Treasury securities. ONRRP denotes the Federal Reserve's overnight reverse repurchase agreement facility.

As the empirical counterpart to the quarter-end funding shock ($R_1 > R_0$, and hence $r_1^B > r_0^B$), Figure B.2 shows both repo and unsecured bank borrowing rates rising at quarter-ends.

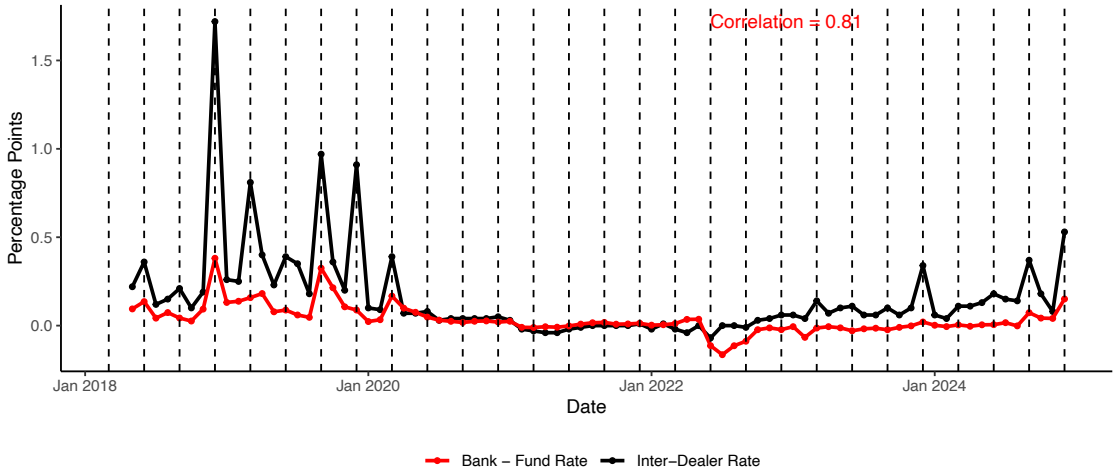
Figure B.2: Bank Debt Borrowing Rates at Quarter-Ends



Notes: This figure plots the market-value-weighted repo rate spreads, defined as in equation 1, in the top panel and unsecured instrument rates in the bottom panel. The dashed vertical lines indicate quarter-end months.

Figure B.3 plots the inter-dealer rate R_t, proxied by the GCF repo rate, which likewise widens at quarter-end.

Figure B.3: Repo Rates across Markets



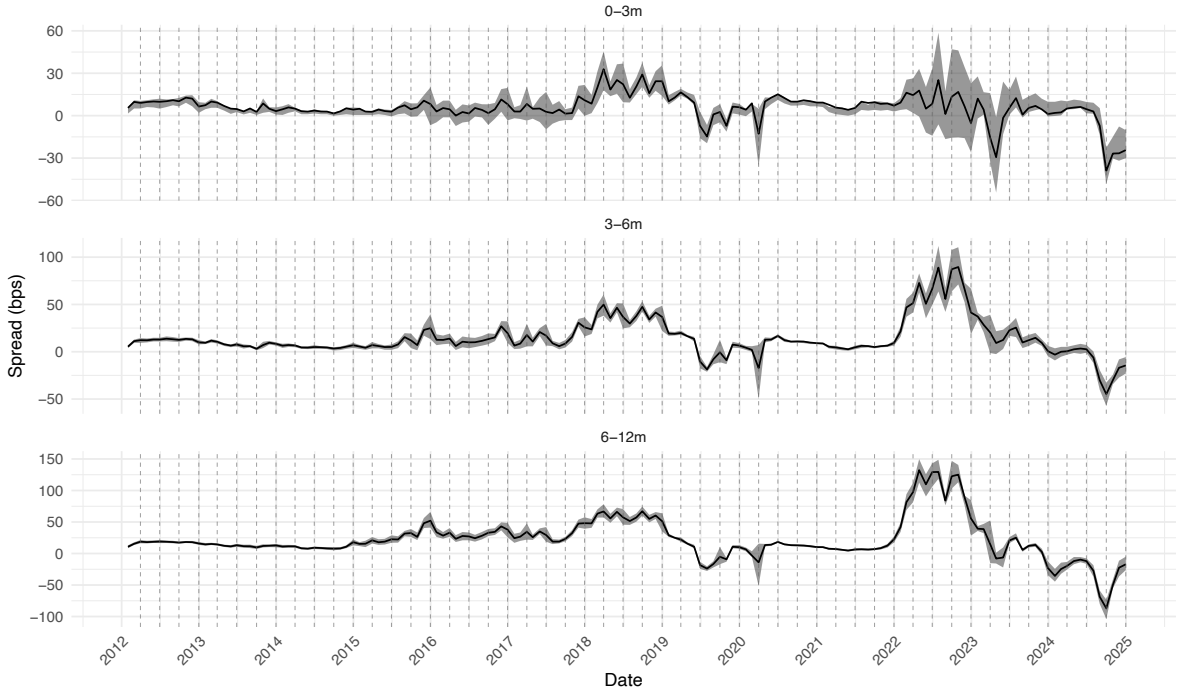
Notes: This figure plots repo rate spread across markets. The red line shows the market-value-weighted repo rate spread reported in Figure B.2, while the other line shows the volume-weighted GCF repo rate in the FICC GCF Repo market, which represents the repo rate in the interdealer market. The dashed vertical lines indicate quarter-end months.

B.2 Robustness and Heterogeneity of the Results in Section 3

B.2.1 Time Series of the Cross-Sectional Spread Distribution

Figure B.4 plots the time series of the cross-sectional security-spread distribution, partitioned into the three remaining-maturity buckets. The solid line is the daily value-weighted average and the shaded region the interquartile range. Two features are apparent. First, baseline spreads increase monotonically in remaining maturity: 0–3 month spreads hover near zero, 3–6 month spreads sit modestly higher, and 6–12 month spreads are highest, reflecting the liquidity and term premia of bills, as shorter-maturity issues are more liquid and carry a lower term premium. Second, cross-sectional dispersion widens noticeably after the MMF reform takes effect in 2016 and again after the tightening cycle begins in 2022, with sizable positive and negative excursions at all three tenors.

Figure B.4: Daily Cross-Sectional Average Security Spread by Remaining-Maturity Bucket



Notes: The figure plots the spread, defined in equation (1), based on daily observations. The sample spans January 2012 to December 2024.

B.2.2 Regime Shifts: Basel III Phase-In and the 2016 MMF Reform

A natural concern with the baseline specification in Table 1 is that pooling 2012–2024 may obscure a structural change in the quarter-end pricing pattern near the middle of the sample. Figure B.4 is consistent with such a break: cross-sectional dispersion is noticeably tighter before 2015 than afterwards, and clear quarter-end dips become visible only from around 2016. The timing coincides with two roughly contemporaneous regulatory changes that operate in the same direction within our framework. First, the phase-in of Basel III supplementary leverage-ratio disclosure requirements for foreign banks sharpened these institutions' incentive to compress their balance sheets at quarter-end (Munyan, 2017; Bassi et al., 2024). Second, the SEC's money market fund reform, whose principal provisions took effect in October 2016, triggered a roughly $1 trillion reallocation from prime to government MMFs and introduced liquidity-fee and redemption-gate provisions for prime funds. Both changes tighten the quarter-end constraints on foreign banks and therefore enlarge the quarter-end

contraction in MMF lending to non-U.S. banks—prime funds shedding unsecured bank debt, government funds shedding foreign-bank-collateralized tri-party repo—leaving the affected MMFs with a narrower set of permissible substitutes, primarily Treasury bills and the Federal Reserve's ONRRP facility. We cannot separately identify the two catalysts from the time series alone; we therefore treat the two regulatory dates as regime cutoffs and re-estimate equation (2) on the Treasury-bills-only sample across three sub-periods.[17]

Table B.1 reports the estimates. In the pre-2015 sub-period (Panel A) the quarter-end coefficient is essentially zero at the 3–6 and 6–12 month buckets, with only a small but statistically significant 1.2-basis-point effect at 0–3 months. Once Basel III is in force but before the MMF reform (Panel B), the coefficient becomes markedly more negative and traces the familiar maturity gradient: 5.5 basis points at 0–3 months, 5.1 at 3–6 months, and 3.5 at 6–12 months, with the longest tenor imprecisely estimated. After the October 2016 MMF reform (Panel C), the short-end effect is larger still. This progression is consistent with the regulatory-regime hypothesis: the front-end yield drop emerges only once foreign banks face binding quarter-end balance-sheet snapshots and the MMF universe absorbing the resulting funding contraction has been narrowed by the SEC money market fund reform.

[17] Although window-dressing patterns in adjacent funding markets are documented as far back as the 1990s, the cross-quarter contraction in non-U.S. bank balance sheets that motivates our spillover hypothesis only becomes binding once the foreign Basel III leverage-ratio disclosure is in place; we therefore use 2015 as the cutoff, in line with Du et al. (2018b) and Wallen (2020).

Table B.1: Quarter-End Effect on T-Bill Spreads, by Sub-Period

Dependent Variable:	Spread (pp)		
Remaining maturity:	0–3 m	3–6 m	6–12 m
Panel A. Pre-Basel III (2012– 2014)			
QEnd_t	-0.0117^{**}	-0.0053	0.0053
	(0.0041)	(0.0046)	(0.0070)
Observations	9,731	9,603	5,752
R^2	0.417	0.794	0.761
Within R^2	0.019	0.304	0.340
Panel B. Basel III, pre-reform (2015–Oct 2016)			
QEnd_t	-0.0548^{*}	-0.0507^{**}	-0.0350
	(0.0277)	(0.0200)	(0.0242)
Observations	5,799	5,749	3,442
R^2	0.274	0.443	0.521
Within R^2	0.072	0.310	0.315
Panel C. Post-MMF reform (Oct 2016 –2024)			
QEnd_t	-0.0659^{***}	-0.0458^{*}	-0.0519
	(0.0239)	(0.0234)	(0.0338)
Observations	44,937	33,390	15,705
R^2	0.256	0.746	0.830
Within R^2	0.084	0.028	0.010

Notes: Estimates of equation (2) on Treasury bills only, split into three sub-periods. All specifications include Issuance × Year-Quarter fixed effects, security controls, and market-level controls. All else as in Table 1.

The portfolio side mirrors this regime shift: Tables B.11 and B.12 in Appendix B.3.4 show that MMF withdrawal magnitudes intensify sharply after 2015, concentrated in unsecured bank debt, while repo magnitudes are essentially unchanged.

B.2.3 Month-End Comparison-Group Robustness

A second concern is that the comparison group—all non-quarter-end trading days—may be too broad: short-term Treasury yields vary over the quarter with market liquidity, fiscal news, and the auction cycle, and fixed effects alone may not absorb this variation cleanly enough to provide a counterfactual for the quarter-end day. We therefore re-estimate the bills-only specification of Table 1 over the full 2012–2024 window with the comparison group restricted to month-end trading days, so that quarter-ends are benchmarked against days on which dealers and investors face similar end-of-month balance-sheet pressures (Table B.2).

Table B.2 reports this month-end specification. The point estimates remain negative and

significant at the shorter maturities and are slightly larger than in the baseline—6.9 basis points at 0–3 months in the bills-only panel and 10.0 basis points in the pooled panel. The front-end yield drop is therefore not an artifact of the broad non-quarter-end comparison group.

Table B.2: Quarter-End Effect on T-Bills: Month-End Comparison Group

Dependent Variable:	Spread (pp)					
Sample:	Panel A. T-bills only			Panel B. Notes + Bonds + Bills		
Remaining maturity:	0–3 m	3–6 m	6–12 m	0–3 m	3–6 m	6–12 m
QEnd_t	-0.0689^{***}	-0.0446^{**}	-0.0298	-0.1003^{***}	-0.0501^{***}	-0.0305
	(0.0230)	(0.0188)	(0.0245)	(0.0198)	(0.0138)	(0.0198)
Issuance × Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Security controls	Yes	Yes	Yes	Yes	Yes	Yes
Market-level controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,910	2,310	1,223	4,563	4,165	5,095
R^2	0.310	0.784	0.838	0.274	0.771	0.859

Notes: Estimates of equation (2) restricting the comparison group to month-end trading days, over the full daily sample from January 2012 through December 2024. Panel A restricts the sample to Treasury bills only; Panel B uses the broader Notes + Bonds + Bills universe. All else as in Table 1.

B.2.4 Heterogeneity by Quarters

We next re-estimate the bills-only baseline separately by calendar quarter. Table B.3 shows that the effect is largest in the fourth quarter (the calendar year-end), consistent with intensified balance-sheet window dressing at year-end; only the third- and fourth-quarter estimates are statistically significant.

Table B.3: Heterogeneity by Calendar Quarter, T-bills only

Dependent Variable:	Spread (pp)				
Sample:	All Quarters	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
QEnd_t	-0.0449^{***}	-0.0255	-0.0342	-0.0482^{*}	-0.0677^{***}
	(0.0108)	(0.0158)	(0.0221)	(0.0252)	(0.0210)
Issuance × Year-Quarter × Bucket FE	Yes	Yes	Yes	Yes	Yes
Security controls	Yes	Yes	Yes	Yes	Yes
Market-level controls	Yes	Yes	Yes	Yes	Yes
Observations	134,108	32,400	33,783	34,320	33,605
R^2	0.601	0.560	0.637	0.656	0.545

Notes: Estimates of equation (2) on the Treasury-bills-only sample, split by calendar quarter. "All Quarters" pools the three maturity buckets with bucket-level fixed effects. All else as in Table 1.

B.2.5 FOMC Meeting Robustness

To rule out an influence of FOMC meetings, we re-estimate the baseline specifications after dropping all FOMC meeting days from the panel. Within the 2012–2024 window, only one FOMC meeting coincides with a quarter-end (March 31, 2020). Table B.4 reports the estimates, which are essentially unchanged relative to Table 1 across all three buckets and both samples, suggesting that the results are not driven by the timing of monetary policy.

Table B.4: Quarter-End Effect Excluding FOMC Days

Dependent Variable:	Spread (pp)					
Sample:	Panel A. T-bills only			Panel B. Notes + Bonds + Bills		
Remaining maturity:	0–3 m	3–6 m	6–12 m	0–3 m	3–6 m	6–12 m
QEnd_t	-0.0558^{***}	-0.0357^{**}	-0.0343	-0.0909^{***}	-0.0409^{***}	-0.0299^{*}
	(0.0175)	(0.0159)	(0.0216)	(0.0182)	(0.0115)	(0.0171)
Issuance × Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Security controls	Yes	Yes	Yes	Yes	Yes	Yes
Market-level controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	58,488	47,155	24,130	96,296	85,324	102,855
R^2	0.244	0.753	0.828	0.187	0.747	0.846
Within R^2	0.066	0.039	0.022	0.017	0.034	0.028

Notes: Estimates of equation (2) after dropping all observations on FOMC meeting dates. Within 2012–2024, only one FOMC meeting (March 31, 2020) lands on a quarter-end day, so this restriction effectively removes the 2020Q1 quarter-end day from the panel. All else as in Table 1.

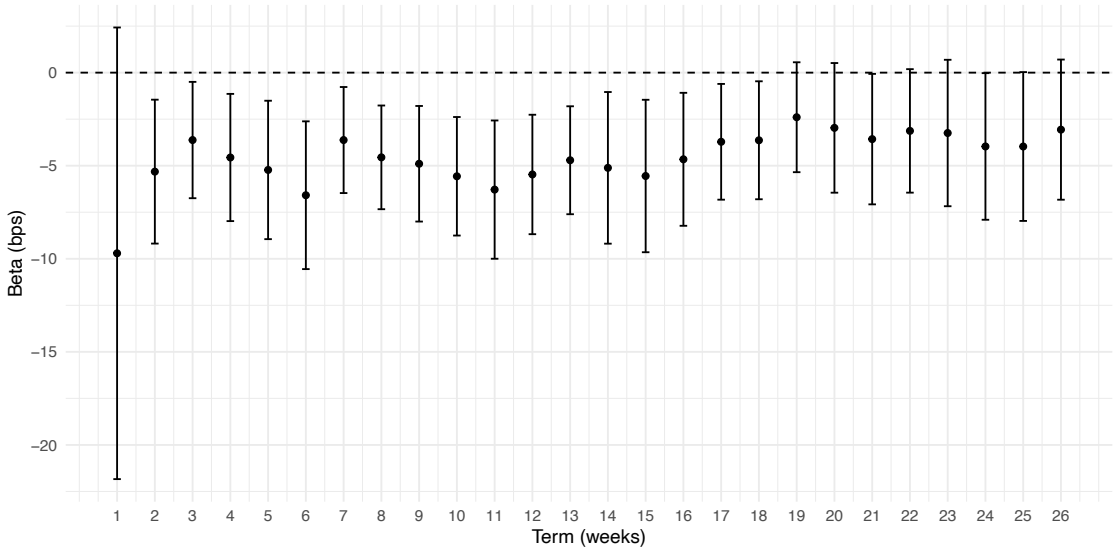
B.2.6 Leave-One-Quarter-Out Analysis

We also conduct a leave-one-quarter-out analysis, re-estimating the bills-only baseline specification while recursively excluding one calendar year-quarter at a time. The results remain stable across all iterations. For the 0–3 month bucket, the most influential quarter is 2024Q3, whose exclusion shrinks the coefficient by 0.94 bps relative to the full-sample estimate of −5.65 bps; for the 3–6 month bucket the most influential quarter is 2022Q4 (0.93-bps reduction in absolute magnitude relative to a −3.59-bps full-sample estimate); for the 6–12 month bucket the same quarter is the most influential, with a 1.04-bps reduction (relative to a −3.44-bps estimate). None of these exclusions affect the statistical significance of the baseline estimates, indicating that the results reflect a persistent pattern rather than a small number of influential quarters.

B.2.7 Index-level regression

As a final check, we replicate the quarter-end analysis using a monthly Fama-Bliss Treasury bill yield index 26-week term structure. This approach provides a direct test of whether the quarter-end pattern is present at the aggregate level. For each month-end observation m, we regress changes in the 26-week spread on a quarter-end dummy. Figure B.5 plots the resulting time series and fitted values: quarter-end months exhibit systematically lower 26-week spreads than non-quarter-end months, with magnitudes largest at 0–3 months maturity bucket and then 3-6 months bucket, in line with Table 1.

Figure B.5: Quarter-End Effect on 26-Week Treasury Bill Spread, Month-End Comparison



Notes: Series constructed from a monthly index-level 26-week Treasury bill yield series; shaded area marks the beta estimated in front of the quarter-end dummy.

B.2.8 Decomposition by Security Type and Original Tenor

Table B.5 restricts the sample to rolled-down notes and bonds across the three remaining-maturity buckets. The 0–3 month coefficient grows in magnitude to −15.4 basis points. The market for rolled-down notes and bonds is less liquid, producing a larger quarter-end yield drop, which helps account for the larger pooled estimate in Panel B of Table 1.

Table B.5: Quarter-End Effect by Security Type

Dependent Variable:	Spread (pp)		
Sample:	Notes + Bonds		
Remaining maturity:	0–3 m	3–6 m	6–12 m
QEnd_t	-0.1539^{***}	-0.0480^{***}	-0.0288
	(0.0366)	(0.0171)	(0.0217)
Issuance × Year-Quarter FE	Yes	Yes	Yes
Security controls	Yes	Yes	Yes
Market-level controls	Yes	Yes	Yes
Observations	39,059	39,434	81,362
R^2	0.162	0.740	0.849

Notes: Estimates of equation (2). The sample retains only rolled-down Treasury notes and bonds (no bills). All else as in Table 1.

Table B.6 pushes this further, splitting the rolled-down notes and bonds with 0–3 month remaining maturity by the security's original auction tenor: the quarter-end drop is uniformly significant and rises with original tenor, from −15.8 basis points for 2–3 year notes to −22.2 basis points for 20–30 year bonds. Both patterns are consistent with an MMF-demand channel whose price impact is smaller for liquid short-term securities and larger for longer-tenor bonds that trade in thinner markets.

Table B.6: Quarter-End Effect by Original Tenor of Notes/Bonds

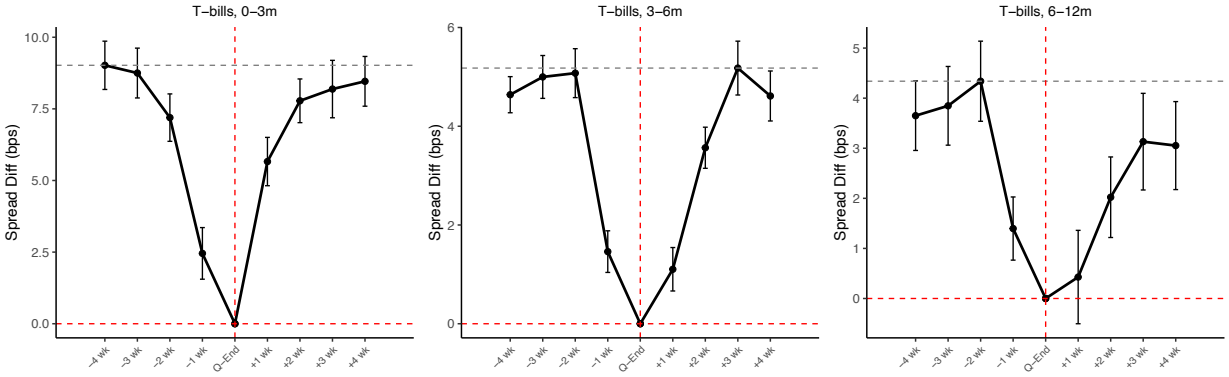
Dependent Variable:	Spread (pp)			
Sample:	Notes + Bonds with 0–3 m residual maturity			
Original tenor:	2–3 y note	5 y note	7–10 y note	20–30 y bond
QEnd_t	-0.1577^{***}	-0.1558^{***}	-0.1691^{***}	-0.2215^{***}
	(0.0403)	(0.0331)	(0.0511)	(0.0813)
Issuance × Year-Quarter FE	Yes	Yes	Yes	Yes
Security controls	Yes	Yes	Yes	Yes
Market-level controls	Yes	Yes	Yes	Yes
Observations	18,568	9,209	9,775	1,507
R^2	0.159	0.169	0.172	0.256

Notes: Estimates of equation (2) on rolled-down Treasury notes and bonds with 0–3 months remaining maturity, split by the security's original auction tenor. All else as in Table 1.

B.2.9 Event-Window Plots by Maturity Bucket and Placebo Tests

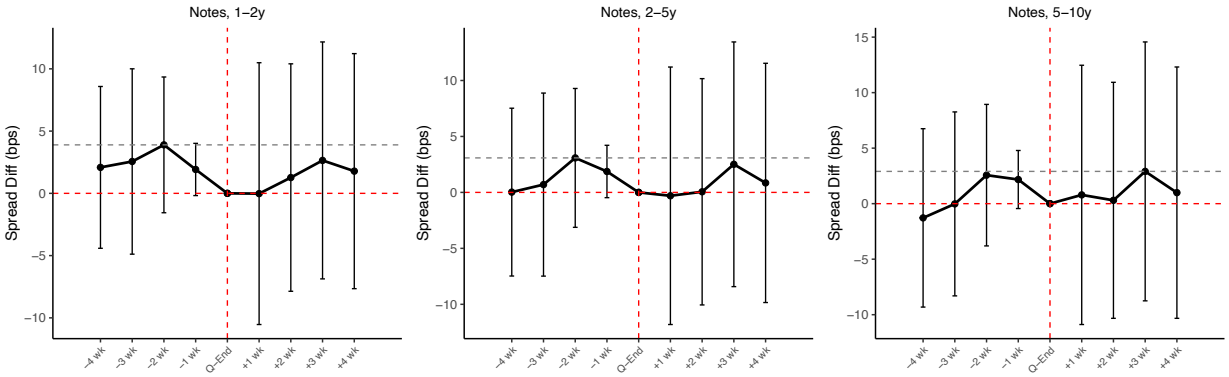
Figure B.6 reports the event-window coefficients for all three remaining-maturity buckets of Treasury bills. The V-shape is present in each bucket but flattens and loses significance as remaining maturity rises. Figures B.7 and B.8 report placebo event studies for Treasury notes and bonds with more than one year remaining maturity. Neither placebo shows a comparable quarter-end V-shape, reinforcing that the effect is concentrated in the short-maturity bills held by MMFs.

Figure B.6: Event-Study around Quarter-Ends for T-bills



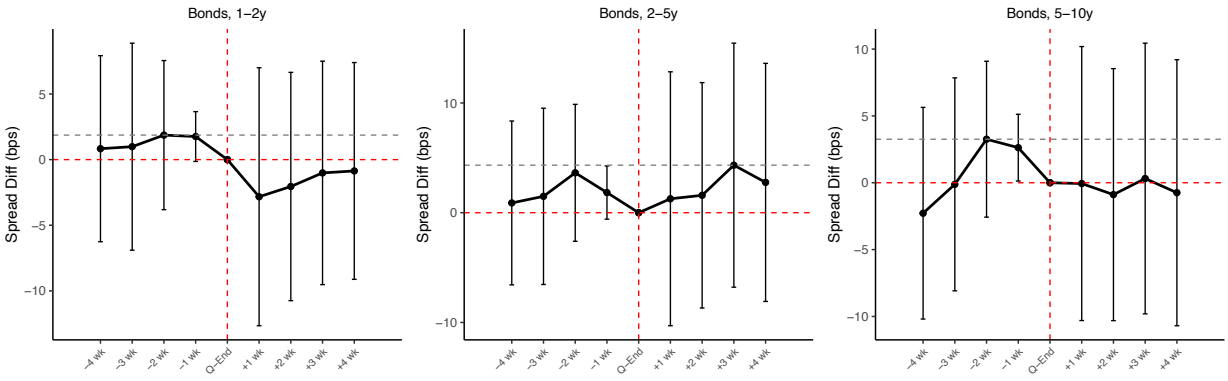
Notes: Event-window coefficients $-\hat{\beta}_k$ from equation (3) for $k \in \{-4, \ldots, +4\}$ weeks, estimated on Treasury bills and shown by remaining-maturity bucket (0–3, 3–6, and 6–12 months). The quarter-end week is normalized to zero; error bars are 95% confidence intervals. The sample spans January 2012 through December 2024.

Figure B.7: Placebo Event-Study: Treasury Notes only, >1y



Notes: Same event-time regression as Figure 1, estimated on Treasury notes with more than one year remaining maturity (bucketed 1–2y / 2–5y / 5–10y). The quarter-end week is normalized to zero; error bars are 95% confidence intervals.

Figure B.8: Placebo Event-Study: Treasury Bonds only, >1y



Notes: Same event-time regression as Figure 1, estimated on Treasury bonds with more than one year remaining maturity (bucketed 1–2y / 2–5y / 5–10y). The quarter-end week is normalized to zero; error bars are 95% confidence intervals.

B.2.10 Zero-Lower-Bound Region Heterogeneity

The pooled estimates in Table 1 average over very different monetary-policy environments, and the measured quarter-end effect need not be constant across them. When the federal funds target range sits at its zero lower bound (ZLB), the policy floor compresses the front-end spread on which MMF demand operates: bill yields are pinned close to zero and have limited room to fall further, so a given amount of quarter-end demand pressure should translate into a smaller observed yield response than in periods when the short rate is well above zero. If so, the reduced-form estimate that pools ZLB and non-ZLB quarters would understate the off-ZLB price impact. We test this by re-estimating the bills-only specification of equation (2) separately by policy-rate regime.

We classify a trading day as ZLB if the lower bound of the federal funds target range is exactly zero. This selects two episodes within the 2012–2024 sample: the post-crisis ZLB, from the start of the sample in January 2012 through 15 December 2015, and the pandemic ZLB, from 16 March 2020 through 16 March 2022. We keep the two episodes separate, because they differ along dimensions other than the policy rate—among them the scale of the Federal Reserve's balance sheet and reverse-repo facility, the level of bill supply, and the post-2015 strengthening of the window-dressing incentive documented in Appendix B.2.2—

and label all remaining days non-ZLB. T-bill trading days split 990, 504, and 1,759 across the GFC-ZLB, COVID-ZLB, and non-ZLB regimes; Figure B.9 plots the policy floor with the two ZLB windows shaded.

Table B.7 re-estimates the quarter-end coefficient within each regime. The front-end yield drop is a non-ZLB phenomenon: in non-ZLB quarters the coefficient is 8.3, 6.5, and 7.6 basis points (in absolute value) across the three maturity buckets and significant throughout, close to the pooled baseline in Table 1. During the GFC ZLB the effect is largely absent, surviving only at the 0–3 month bucket and at a much smaller 1.3 basis points; during the COVID ZLB it is statistically indistinguishable from zero at every maturity.

Table B.8 confirms this pattern in a single pooled regression that interacts the quarter-end indicator with the three regime dummies, which allows the regime differences to be tested directly. Both ZLB coefficients are significantly smaller in absolute value than the non-ZLB coefficient: the GFC-minus-non-ZLB difference is 7.3, 5.7, and 7.1 basis points and the COVID-minus-non-ZLB difference 8.6, 7.6, and 10.1 basis points, significant in every bucket. The two ZLB coefficients are not significantly different from one another, so we read the attenuation as a common feature of the zero-rate environment rather than as specific to either episode.

Two qualifications apply to the COVID results. The pandemic ZLB contains only eight quarter-ends, so its coefficients are estimated imprecisely, and the failure to detect an effect reflects limited statistical power as much as a true null. Relatedly, the small residual effect at the 0–3 month bucket during the GFC ZLB, absent during the COVID ZLB, should not be read as evidence that the attenuation was more complete under the pandemic, since the two ZLB coefficients cannot be distinguished. With these caveats, the regime split is consistent with the truncation mechanism above: where the spread can move freely the quarter-end yield drop is several basis points, and where the policy floor binds the measured response collapses. It also implies that the pooled estimates in Table 1, which include the two ZLB episodes, are if anything conservative measures of the off-ZLB price impact.

Table B.7: Quarter-End Effect on T-Bill Spreads by Policy-Rate Regime

Dependent Variable:	Spread (pp)								
Regime:	ZLB–GFC			ZLB–COVID			Non-ZLB		
Remaining maturity:	0–3 m	3–6 m	6–12 m	0–3 m	3–6 m	6–12 m	0–3 m	3–6 m	6–12 m
QEnd_t	-0.0132^{***}	-0.0099	0.0023	0.0012	-0.0023	-0.0027	-0.0833^{***}	-0.0645^{**}	-0.0760^{**}
	(0.0040)	(0.0063)	(0.0078)	(0.0094)	(0.0138)	(0.0245)	(0.0284)	(0.0275)	(0.0350)
Issuance × Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Security controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Market-level controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	12,854	12,675	7,594	12,960	9,936	3,852	34,653	26,131	13,453
R^2	0.404	0.543	0.670	0.467	0.729	0.809	0.269	0.746	0.832
Within R^2	0.019	0.164	0.194	0.121	0.034	0.066	0.101	0.041	0.016

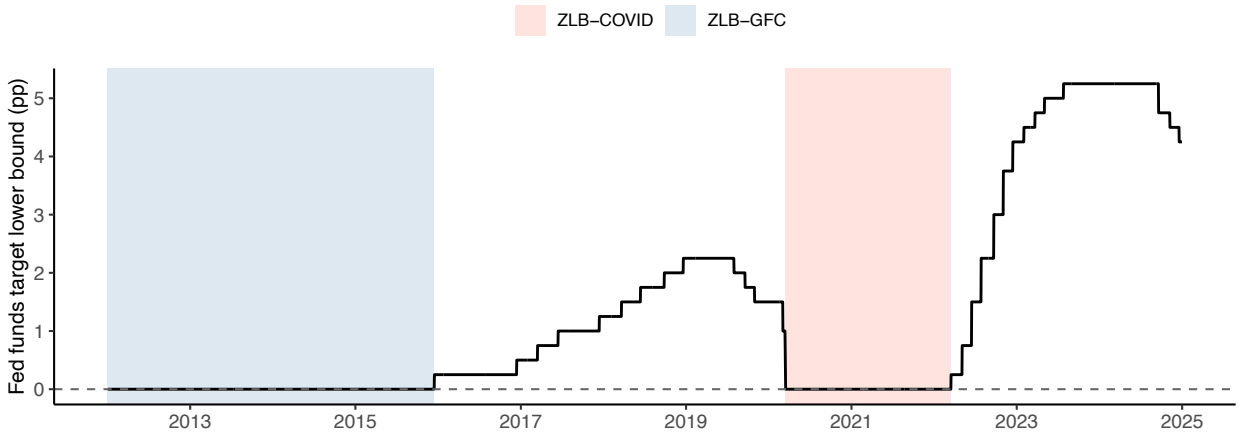
Notes: OLS estimates of equation (2) on Treasury bills only, estimated separately within each policy-rate regime. A trading day is ZLB if the lower bound of the federal funds target range equals zero (ZLB–GFC: January 2012–15 December 2015; ZLB–COVID: 16 March 2020–16 March 2022); all other days are non-ZLB. Security-level controls are duration and the bid–ask spread; market-level controls are the volume of newly auctioned Treasury bills and the face amount of maturing Treasury debt. Standard errors, clustered at the year-quarter level, are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table B.8: Quarter-End Effect by Policy-Rate Regime: Pooled Interaction

Dependent Variable:	Spread (pp)		
Remaining maturity:	0–3 m	3–6 m	6–12 m
$\text{QEnd}_t \times$ Non-ZLB	-0.0887^{***}	-0.0649^{**}	-0.0691^{*}
	(0.0273)	(0.0267)	(0.0358)
$\text{QEnd}_t \times$ ZLB–GFC	-0.0157^{***}	-0.0080	0.0021
	(0.0046)	(0.0056)	(0.0074)
$\text{QEnd}_t \times$ ZLB–COVID	-0.0028	0.0115	0.0316
	(0.0137)	(0.0154)	(0.0298)
Difference tests ($\delta = \beta_{\text{ZLB}} - \beta_{\text{Non-ZLB}}$):			
ZLB–GFC − Non-ZLB	0.0730^{***}	0.0569^{**}	0.0712^{*}
	(0.0268)	(0.0273)	(0.0368)
ZLB–COVID − Non-ZLB	0.0859^{***}	0.0764^{**}	0.1007^{**}
	(0.0286)	(0.0308)	(0.0474)
Issuance × Year-Quarter FE	Yes	Yes	Yes
Security controls	Yes	Yes	Yes
Market-level controls	Yes	Yes	Yes
Observations	60,467	48,742	24,899
R^2	0.245	0.752	0.827
Within R^2	0.066	0.038	0.023

Notes: OLS estimates of equation (2) on Treasury bills, pooling all regimes and interacting QEnd_t with indicators for the non-ZLB, ZLB–GFC, and ZLB–COVID regimes; the regime level effects are absorbed by the year-quarter fixed effects. The difference-test rows report $\delta = \beta_{\text{ZLB}} - \beta_{\text{Non-ZLB}}$, with standard errors computed from the estimated coefficient covariance matrix; a positive δ indicates a weaker (less negative) quarter-end yield drop at the ZLB. Controls, fixed effects, clustering, and significance stars are as in Table B.7.

Figure B.9: Federal Funds Target Lower Bound and ZLB Regimes



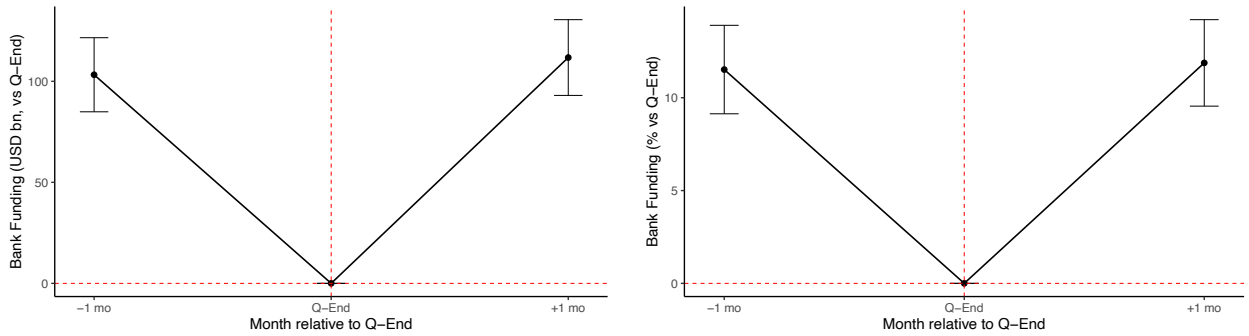
Notes: Daily lower bound of the federal funds target range, January 2012 through December 2024. Shaded regions mark the two zero-lower-bound episodes used in Tables B.7 and B.8: the post-crisis ZLB (through 15 December 2015) and the pandemic ZLB (16 March 2020–16 March 2022).

B.3 Robustness and Heterogeneity of the Results in Section 5

B.3.1 Aggregate Bank-Funding Event Study

Figure B.10 presents the event-study counterpart to the aggregate sawtooth series, averaging the change in MMF bank-funding holdings in the months around each quarter-end; the contraction is concentrated at the quarter-end ($t = 0$) and reverses the following month.

Figure B.10: Event Study of Aggregate Bank Funding



Δ Quantity (USD bn) vs. Q-End

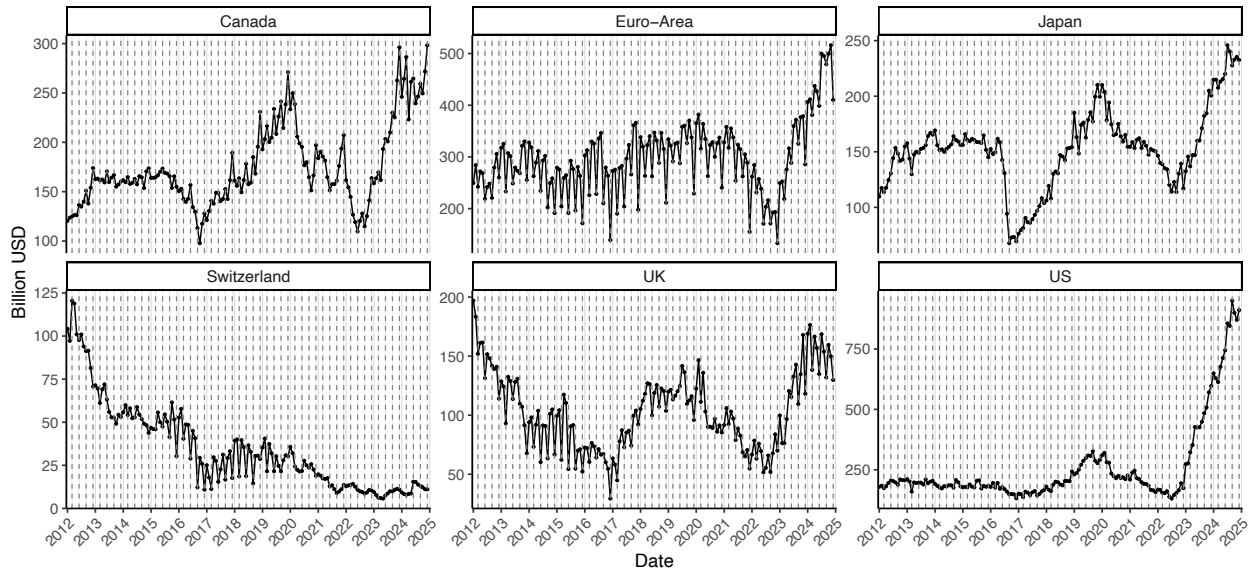
% change vs. Q-End

Notes: The figure plots aggregate MMF holdings of bank funding (repo plus unsecured) in event time, over a window of ±1 month around the quarter-end ($t = 0$, normalized to zero). The left panel reports the change in holdings in USD billions and the right panel the percentage change. The sample spans 2012–2024, and the shaded bands denote 95% confidence intervals.

B.3.2 Decomposition by Issuer Region and Instrument

This appendix collects the decompositions of the aggregate quarter-end contraction summarized in Section 5.1. Figure B.11 decomposes MMF holdings of bank debt by the headquarters region of the issuing bank. The quarter-end pattern is concentrated in non-U.S. banks—especially those headquartered in the Euro area, the UK, and Japan—which compute their leverage ratio from a quarter-end snapshot, whereas U.S. banks use a daily quarterly average and show no recurring quarter-end contraction. Canadian banks follow fiscal quarter-ends one month after the calendar quarter-ends, so their dip does not align with the dashed lines.

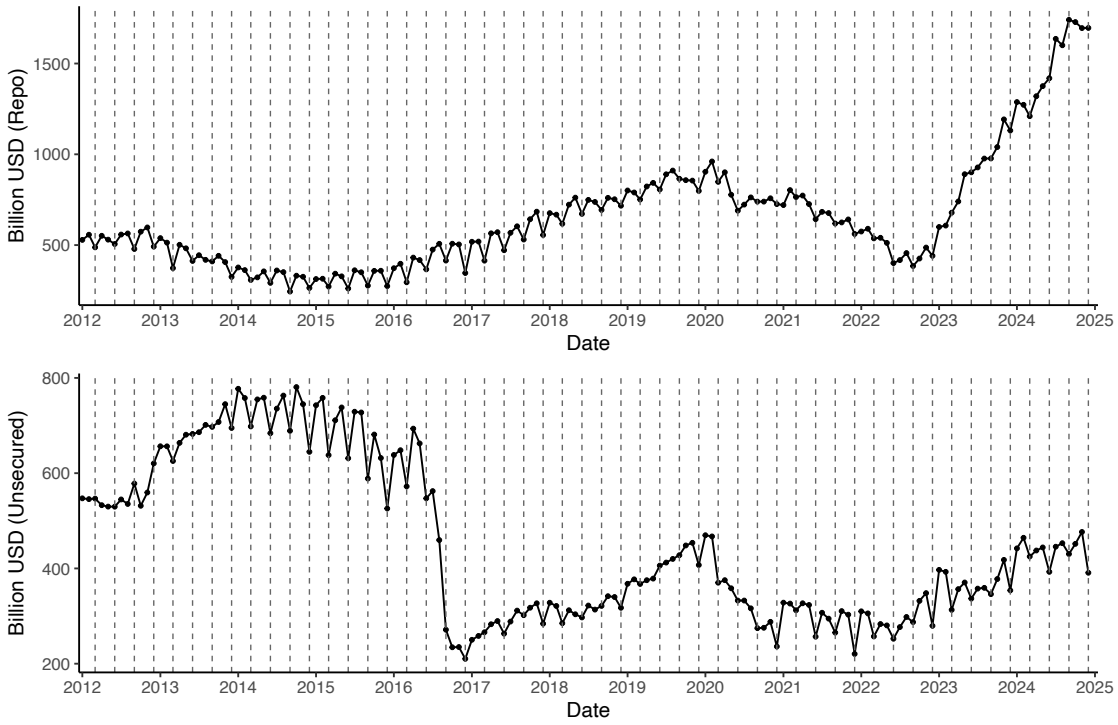
Figure B.11: Aggregate MMF Bank-Funding Holdings by Issuer Region around Quarter-Ends



Notes: The figure plots aggregate MMF holdings of bank debt by the headquarters region of the issuing bank, irrespective of security type. Dashed vertical lines mark standard calendar quarter-end dates. Canadian banks report on fiscal quarter-ends that fall one month after the calendar quarter-ends, so their quarter-end reduction does not align with the dashed lines. The sample spans 2012–2024.

Figure B.12 decomposes aggregate holdings into secured (repo) and unsecured (CP, CD, and time deposits) instruments. The recurring quarter-end contraction is visible in both panels, indicating that the window-dressing pattern operates symmetrically across both funding channels. The two series differ in trend: unsecured holdings drop sharply around late 2016 and remain structurally lower thereafter, reflecting the SEC's money market fund reform, whose principal provisions took effect in October 2016, when prime funds—the main holders of unsecured bank debt—lost roughly $1 trillion of assets to government funds, which by mandate cannot hold unsecured bank debt. Repo holdings, by contrast, continue to grow, since government funds can hold repo backed by Treasury or agency collateral. The 2016 level shift is therefore a regulatory artifact rather than evidence against the window-dressing channel: the quarter-end seasonality is preserved both before and after 2016, only on a smaller base.

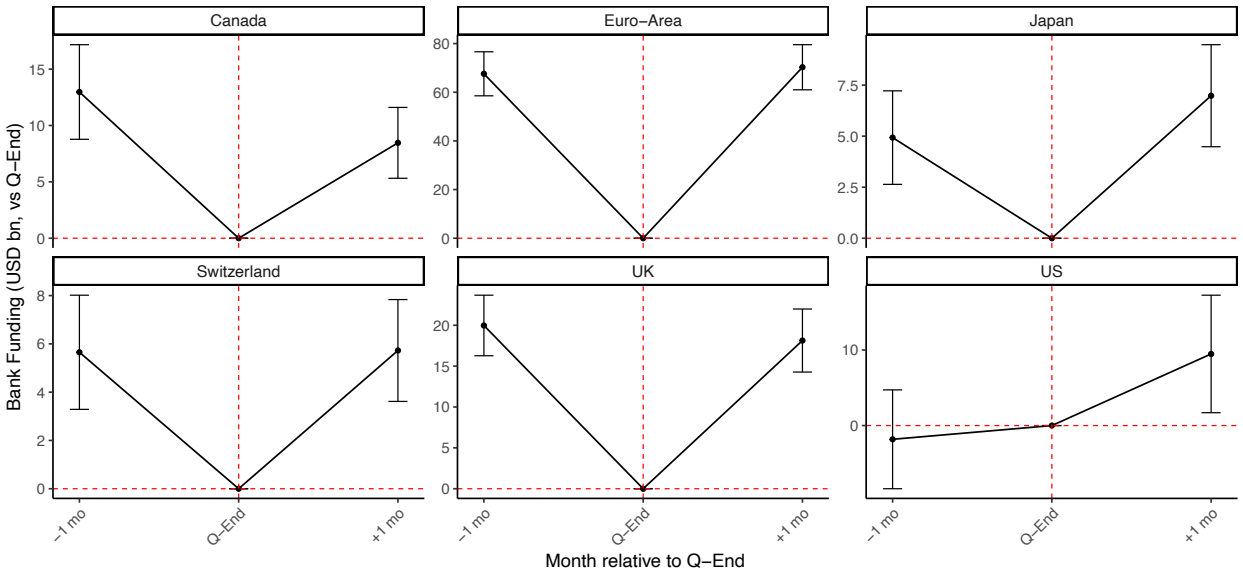
Figure B.12: MMF Holdings of Unsecured Bank Debt and Repo around Quarter-Ends



Notes: The figure plots aggregate MMF holdings of bank debt by security type, irrespective of issuer region. Dashed vertical lines mark standard calendar quarter-end dates. The top panel plots repurchase agreements (repo) of all collateral types and the bottom panel plots unsecured instruments (commercial paper, certificates of deposit, and time deposits). The sample spans 2012–2024.

Figures B.13–B.14 report the event-window companions to main-text Figure B.10, in dollar-change terms, by issuer region and separately for repo and unsecured instruments. In each case holdings fall sharply in the quarter-end month and rebound the following month, with the decline concentrated in Euro-area, UK, and Japanese banks and spread across both repo and unsecured instruments.

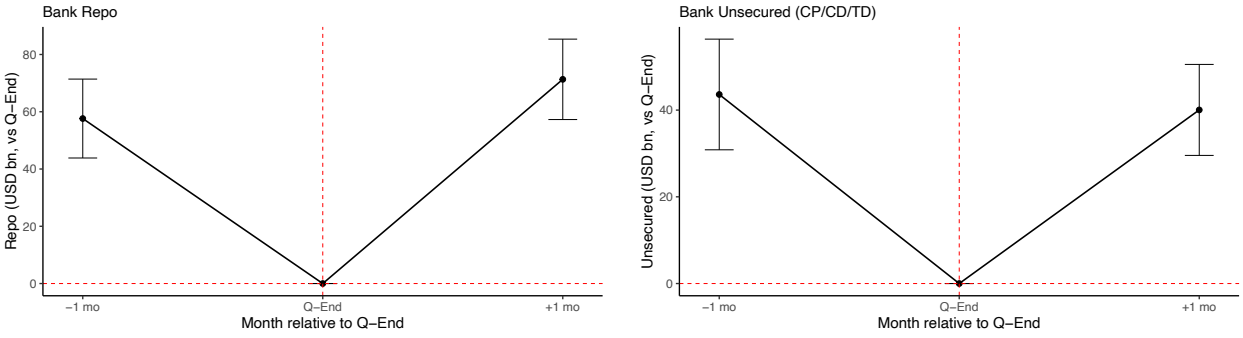
Figure B.13: Event Window: Bank Funding by Issuer Region



Δ Quantity (USD bn)

Notes: The figure plots event-time averages of the change in MMF bank-funding holdings (in USD billions) by issuer region around each region's quarter-end. Canadian banks' quarter-ends are shifted one month (January, April, July, and October) to match their fiscal calendar; all other regions use the March, June, September, and December anchors. The sample spans 2012–2024, and error bars denote 95% confidence intervals.

Figure B.14: Event Window: Bank Repo and Unsecured Debt



Bank Repo Unsecured Debt

Notes: The figure plots event-time averages of MMF holdings against bank counterparties around quarter-ends. The left panel reports repo holdings and the right panel unsecured holdings (commercial paper, certificates of deposit, and time deposits), each as the change in holdings in USD billions. The sample spans 2012–2024, and error bars denote 95% confidence intervals.

B.3.3 Bank–Fund-Level Evidence on the Intensive and Extensive Margin

We examine the extensive margin at the bank-fund level, repeating the analysis of Table 3 on both sides of the fund-bank network: whether funds cut the number of banks they fund at quarter-end, and whether banks lose funding relationships as the number of funds lending to them falls. Table B.9 reports results consistent with the main extensive-margin findings: quarter-end months bring a statistically significant reduction in both the number of banks per fund and the number of funds per bank, across repo, unsecured debt, and the pooled specification.

Table B.9: Magnitude of Window Dressing: Extensive Margin

Dependent Variable:	Banks per Fund			Funds per Bank		
Asset Class:	Repo	Unsecured Debt	Both	Repo	Unsecured Debt	Both
QEnd_t	-0.1679^{***}	-0.7799^{***}	-0.5322^{***}	-1.216^{***}	-1.128^{***}	-1.553^{***}
	(0.0181)	(0.0469)	(0.0258)	(0.1828)	(0.0991)	(0.1169)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fund × Year-Quarter FE	Yes	Yes	Yes			
Bank × Year-Quarter FE				Yes	Yes	Yes
Observations	21,909	11,173	23,215	4,056	8,722	9,288
R^2	0.97144	0.96780	0.98499	0.98119	0.98203	0.98975
Within R^2	0.02401	0.05153	0.04010	0.04576	0.04899	0.05978

Notes: Columns (1)–(3) aggregate the data to the fund-year-month level and regress the number of unique banks with which a fund holds a positive position in the indicated asset class at month-end t on the quarter-end indicator, including fund × year-quarter fixed effects. Columns (4)–(6) aggregate to the bank-year-month level and regress the number of unique funds with a positive position in a given bank at month-end t on the quarter-end indicator, including bank × year-quarter fixed effects. Standard errors are reported in parentheses, and ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

For the intensive margin, we estimate the below specification in the same spirit as in equation (12)

$$\text{Value}_{i,j,t} = \beta\, \text{QEnd}_t + \gamma' X_{i,j,t} + \alpha_{i,q(t)} + \mu_{j,q(t)} + \varepsilon_{i,j,t}, \tag{B.1}$$

where i indexes a money market fund, j indexes a bank issuer, $X_{i,j,t}$ denotes the set of controls, and $\alpha_{i,q(t)}$ and $\mu_{j,q(t)}$ are Fund × Year-Quarter and Issuer × Year-Quarter fixed effects, respectively. Because the specification conditions on continuing fund-bank relationships and absorbs both fund-side and issuer-side quarterly shocks, β captures the within-pair

contraction in exposures at quarter-end.

Table B.10 reports the results. The coefficient on QEnd_t is negative and statistically significant for both book-value and market-value measures across all asset classes. The estimated contraction is approximately \$0.032 billion per fund-bank pair for repo, \$0.016 billion per pair for unsecured debt, and \$0.026 billion per pair when both asset classes are pooled. The similarity between book-value and market-value estimates indicates that the contraction is not a valuation artifact. Moreover, the inclusion of issuer-side fixed effects helps rule out bank-specific quarterly shocks as the driver of the result.

Table B.10: Magnitude of Window Dressing: Intensive Margin Within Fund-Bank Pairs

Dependent Variables:	Book Value	Market Value	Book Value	Market Value	Book Value	Market Value
Asset Class:	Repo		Unsecured Debt		Both	
QEnd_t	-0.0324^{***}	-0.0324^{***}	-0.0163^{***}	-0.0163^{***}	-0.0260^{***}	-0.0259^{***}
	(0.0028)	(0.0028)	(0.0015)	(0.0015)	(0.0016)	(0.0016)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fund × Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Issuer × Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	158,717	158,717	207,952	207,952	338,132	338,132
R^2	0.472	0.472	0.588	0.588	0.446	0.446
Within R^2	0.0014	0.0014	0.0037	0.0037	0.0036	0.0036

Notes: The table reports fund-bank-pair OLS estimates of equation (B.1), where i indexes a fund, j indexes a bank issuer, and t indexes a month-end. The dependent variable is the book or market value of the pair's holdings in the indicated asset class (in USD billions). Fund × year-quarter fixed effects absorb fund-level quarterly shocks and issuer × year-quarter fixed effects absorb issuer-level quarterly shocks, so β measures the within-pair, within-quarter contraction at quarter-end. Standard errors are reported in parentheses, and ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

B.3.4 Window-Dressing Magnitude: Pre vs. Post Basel III

Appendix B.2.2 shows that the front-end yield drop is essentially absent before 2015 and emerges sharply once non-U.S. banks become subject to point-in-time leverage-ratio disclosure under Basel III. If our channel is correct, we should expect a parallel pattern on the MMF portfolio side: the magnitude of MMF withdrawal from bank funding at quarter-end should also be larger after 2015. We test this directly by re-estimating Tables 4 and B.10 separately on pre-2015 and post-2015 sub-samples, focusing on market-value outcomes for

parsimony.[18]

Table B.11 reports the fund-level total-exposure split. The contraction in repo holdings is comparable across regimes ($0.39 billion per fund-month before 2015 vs. $0.35 billion afterwards), but the contraction in unsecured holdings widens dramatically post-2015: from $0.14 billion before 2015 to $0.85 billion after, a roughly six-fold increase. When the two asset classes are pooled, the post-2015 fund-level contraction ($0.70 billion) exceeds the pre-2015 contraction ($0.46 billion) by about 50%. The pattern is consistent with foreign banks shifting more aggressively out of unsecured funding once their balance-sheet snapshot rule begins binding, and with U.S. MMFs absorbing the corresponding withdrawal.

Table B.11: Fund-Level Total Exposure: Pre vs. Post Basel III

Dependent Variable:	Market Value (USD billions)					
Sample period:	Pre-Basel III (<2015)			Post-Basel III (≥2015)		
Asset class:	Repo	Unsec.	Both	Repo	Unsec.	Both
QEnd_t	-0.3929^{***}	-0.1442^{***}	-0.4633^{***}	-0.3514^{***}	-0.8502^{***}	-0.6955^{***}
	(0.0270)	(0.0413)	(0.0326)	(0.0315)	(0.0569)	(0.0382)
Fund × Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6,218	4,222	6,571	16,095	6,950	16,674
R^2	0.973	0.994	0.995	0.988	0.989	0.990
Within R^2	0.070	0.006	0.065	0.016	0.076	0.042

Notes: The table re-estimates equation (12) on the pre- and post-2015 sub-samples, with the market value of fund-level holdings (in USD billions) as the dependent variable, reported separately for repo, unsecured debt, and the two pooled. All specifications include fund × year-quarter fixed effects. Standard errors are reported in parentheses, and ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table B.12 applies the same pre/post-2015 split to the extensive-margin regressions of Table 3. Panel A reports the year-month specification, in which the dependent variable is the count of unique money funds holding the indicated asset class at month-end. The post-2015 estimates are statistically significant across all three asset classes (-1.40, -0.98, and -1.26 funds for repo, unsecured, and both pooled, respectively), whereas the pre-2015 estimates are noisier and only marginally significant for repo. Panel B reports the year-month-by-fund

[18]Security-level controls (duration, ratings, repo haircut) are dropped here because the cleaned MMF panel records weighted-average-maturity and credit-rating fields only from 2016 onward; including them would mechanically empty the pre-Basel III sample. The QEnd coefficient is identified by within-fund (and within-pair) variation absorbed by the fixed effects, so it remains cleanly interpretable without those controls.

specification, in which the dependent variable is the number of unique bank counterparties of a given fund at month-end. The contrast across regimes is sharpest for unsecured debt, where the post-2015 estimate of −1.16 banks per fund is roughly six times the pre-2015 estimate of −0.20; the repo estimate is essentially unchanged across regimes, and the pooled estimate is about 2.5 times larger after 2015.

Table B.12: Extensive Margin: Pre vs. Post Basel III

Sample period:	Pre-Basel III (<2015)			Post-Basel III (≥2015)		
Asset class:	Repo	Unsec.	Both	Repo	Unsec.	Both
Panel A. Active Funds per Month (Year-Month panel)						
QEnd_t	−3.625*	−1.417	−2.833	−1.400***	−0.975**	−1.263***
	(1.962)	(0.814)	(1.798)	(0.423)	(0.366)	(0.398)
Observations	36	36	36	120	120	120
R^2	0.753	0.803	0.714	0.981	0.996	0.992
Within R^2	0.224	0.209	0.186	0.136	0.107	0.150
Panel B. Banks per Active Fund (Year-Month × Fund panel)						
QEnd_t	−0.1695***	−0.2038***	−0.2698***	−0.1628***	−1.164***	−0.6395***
	(0.0331)	(0.0616)	(0.0437)	(0.0205)	(0.0640)	(0.0307)
Fund × Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6,218	4,222	6,571	16,095	6,950	16,674
R^2	0.956	0.977	0.985	0.975	0.965	0.985
Within R^2	0.008	0.005	0.011	0.007	0.086	0.049

Notes: The table re-estimates the two extensive-margin specifications of Table 3 separately on the pre- and post-2015 sub-samples. Panel A aggregates the data to a year-month panel, with the count of unique funds holding the indicated asset class as the dependent variable. Panel B aggregates to a fund-year-month panel, with the count of unique bank counterparties of fund i as the dependent variable and fund × year-quarter fixed effects. Standard errors are reported in parentheses, and ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table B.13 reports the intensive-margin contraction across the two regimes at two levels of aggregation: the fund level (Panel A) and within continuing fund-bank pairs (Panel B). At both levels, the contraction in unsecured exposures strengthens markedly after 2015.

Table B.13: Intensive Margin, Fund-Level and Within Fund-Bank Pairs: Pre vs. Post Basel III

Dependent Variable:	Market Value (USD billions)					
Sample period:	Pre-Basel III (<2015)			Post-Basel III (≥2015)		
Asset class:	Repo	Unsec.	Both	Repo	Unsec.	Both
Panel A. Fund-Level Total Exposure (Fund × Year-Quarter FE)						
QEnd_t	-0.4077^{***}	-0.1407^{***}	-0.4633^{***}	-0.3443^{***}	-0.8335^{***}	-0.6955^{***}
	(0.0278)	(0.0416)	(0.0326)	(0.0318)	(0.0568)	(0.0382)
Observations	6,223	4,219	6,581	16,135	6,963	16,745
R^2	0.970	0.994	0.995	0.988	0.989	0.990
Within R^2	0.0697	0.0061	0.0648	0.0148	0.0731	0.0418
Panel B. Within Fund-Bank Pairs (Fund × Issuer × YQ FE)						
QEnd_t	-0.0428^{***}	-0.0033^{*}	-0.0195^{***}	-0.0299^{***}	-0.0210^{***}	-0.0298^{***}
	(0.0032)	(0.0018)	(0.0017)	(0.0032)	(0.0020)	(0.0020)
Observations	44,202	78,885	112,905	135,602	147,416	262,728
R^2	0.469	0.639	0.581	0.464	0.633	0.490
Within R^2	0.0022	0.0000	0.0005	0.0002	0.0006	0.0003

Notes: The table re-estimates the intensive-margin (market-value) specifications separately on the pre- and post-2015 sub-samples, with the market value of holdings (in USD billions) as the dependent variable. Panel A is the fund-level specification of equation (12) (fund × year-quarter fixed effects); Panel B is the fund-bank-pair specification of equation (B.1), which additionally absorbs issuer × year-quarter fixed effects. Security controls are omitted for comparability with the pre-2015 sample. Standard errors are reported in parentheses, and ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Together, Tables B.11-B.13 show that the timing and composition of MMF withdrawal from non-U.S. bank funding line up with the post-2015 strengthening of the regulatory window-dressing incentive documented in Section 3 and Appendix B.2.2.

B.3.5 Same-Fund Substitution by Sub-Period and by Fund Type

Table B.14 re-estimates the same-fund reallocation of Table 6 (in dollar units) separately on the 2012–2014, 2015–Oct 2016, and Oct 2016–2024 sub-periods. The Treasury loading on withdrawn bank funding stays positive and significant throughout, easing from about \$0.18 per dollar before 2015 to roughly \$0.10 afterward, so the substitution into Treasuries survives in every regime. The RRP loading, by contrast, rises sharply once the Federal Reserve's overnight reverse repo facility expands—from \$0.34 per dollar in 2012–2014 to \$0.77 in 2015–Oct 2016 and \$0.59 thereafter—so the RRP becomes the dominant destination for withdrawn funding in the later regimes.

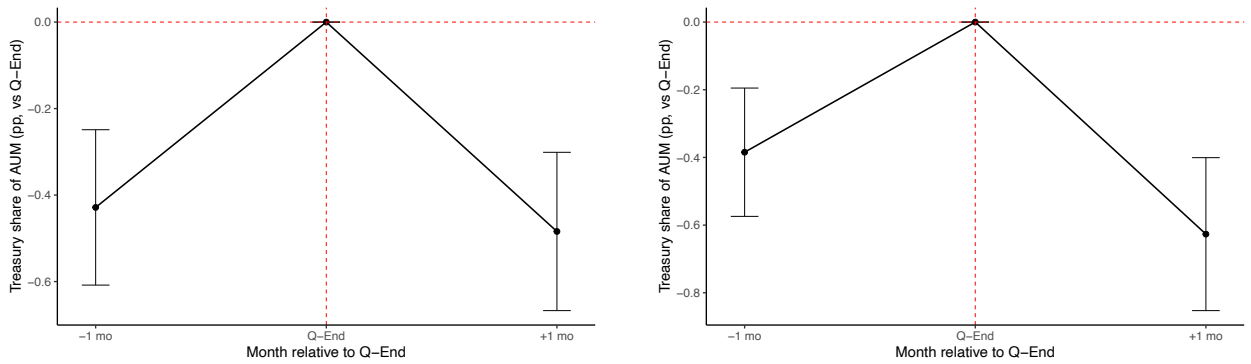
Table B.14: Same-Fund Reallocation into Treasuries and RRP, by Sub-Period

Dependent Variable:	ΔTreasury ($bn)			ΔRRP ($bn)		
Sub-period:	2012–2014	2015–Oct 2016	Oct 2016–2024	2012–2014	2015–Oct 2016	Oct 2016–2024
Model:	(1)	(2)	(3)	(4)	(5)	(6)
$-\Delta$ BankFunding	0.180***	0.103**	0.104***	0.344***	0.772***	0.589***
	(0.042)	(0.048)	(0.032)	(0.054)	(0.097)	(0.050)
NetFlow (control)	0.170***	0.123***	0.117***	0.248***	0.511***	0.524***
	(0.034)	(0.035)	(0.025)	(0.059)	(0.051)	(0.047)
Fund × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,364	1,245	4,571	2,364	1,245	4,571
Within R^2	0.096	0.087	0.057	0.154	0.527	0.432

Notes: The table re-estimates equation (13) (in dollar units) separately on the 2012–2014, 2015–Oct 2016, and Oct 2016–2024 sub-samples, using quarter-end months. The dependent variables are the within-fund changes in Treasury and RRP holdings (in USD billions); $-\Delta$ BankFunding is the negative of the change in the fund's bank-funding holdings, and the fund's net flow enters as a control. All specifications include fund × year fixed effects. Standard errors are reported in parentheses, and ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Figure B.15 reproduces the fund-level Treasury-share event window of main-text Figure 4 separately for government (panel a) and prime (panel b) MMFs. In both groups the Treasury/AUM share peaks at the quarter-end and is lower in the surrounding months. For government funds, whose share averages about 40.9 pp at the quarter-end, it is 0.43 pp lower one month before and 0.48 pp lower one month after, each roughly 1% of the base. For prime funds, whose share averages only 8.2 pp, the absolute dips are similar (0.39 pp one month before and 0.63 pp one month after) but represent much larger proportional swings, about 4.7% and 7.7% of the base, reflecting prime funds' more aggressive quarter-end rotation into Treasuries. All four estimates are statistically significant.

Figure B.15: Treasury Share Event Window by Fund Type



(a) Government MMFs (b) Prime MMFs

Notes: The figure repeats the fund-level Treasury-share event window of Figure 4, restricted to government MMFs (panel a) and prime MMFs (panel b). The specification includes fund × event-quarter fixed effects. The sample spans 2012–2024, and error bars denote 95% confidence intervals.

B.4 Robustness of the Results in Section 6

B.4.1 Proof of Orthogonality with Assumption 1

Proof 1

$$
\begin{aligned}
&\mathbb{E}\Big[\epsilon_{t,\tau} \cdot WDIT^{QE}_{t,\tau} \;\Big|\; \alpha_t, \gamma_{\tau,q(t)}, X_{t,\tau}\Big] \\
&= \mathbb{E}\left[\epsilon_{t,\tau} \sum_{i,j} \mathbf{1}(\cdot)\theta^{Bill}_{i,\tau,t-1}\theta^{Bank}_{i,j,t-1}\Delta Debt_{j,t} \;\middle|\; \alpha_t, \gamma_{\tau,q(t)}, X_{t,\tau}\right] && \Big\}\textit{Substitute the definition} \\
&= \sum_{i,j} \mathbb{E}\Big[\epsilon_{t,\tau}\mathbf{1}(\cdot)\theta^{Bill}_{i,\tau,t-1}\theta^{Bank}_{i,j,t-1}\Delta Debt_{j,t} \;\Big|\; \alpha_t, \gamma_{\tau,q(t)}, X_{t,\tau}\Big] && \Big\}\textit{Linearity} \\
&= \sum_{i,j} \mathbb{E}\Big[\mathbf{1}(\cdot)\Delta Debt_{j,t}\, \mathbb{E}_{\tau,j,t}\Big[\epsilon_{t,\tau}\theta^{Bill}_{i,\tau,t-1}\theta^{Bank}_{i,j,t-1} \;\Big|\; \alpha_t, \gamma_{\tau,q(t)}, X_{t,\tau}\Big] \;\Big|\; \alpha_t, \gamma_{\tau,q(t)}, X_{t,\tau}\Big] && \Big\}\textit{Law of iterated expectation} \\
&= \sum_{i,j} \mathbb{E}\Big[\mathbf{1}(\cdot)\Delta Debt_{j,t} \cdot 0 \;\Big|\; \alpha_t, \gamma_{\tau,q(t)}, X_{t,\tau}\Big] && \Big\}\textit{By Assumption} \\
&= 0
\end{aligned}
$$

B.4.2 Algebra of Rotemberg Weights

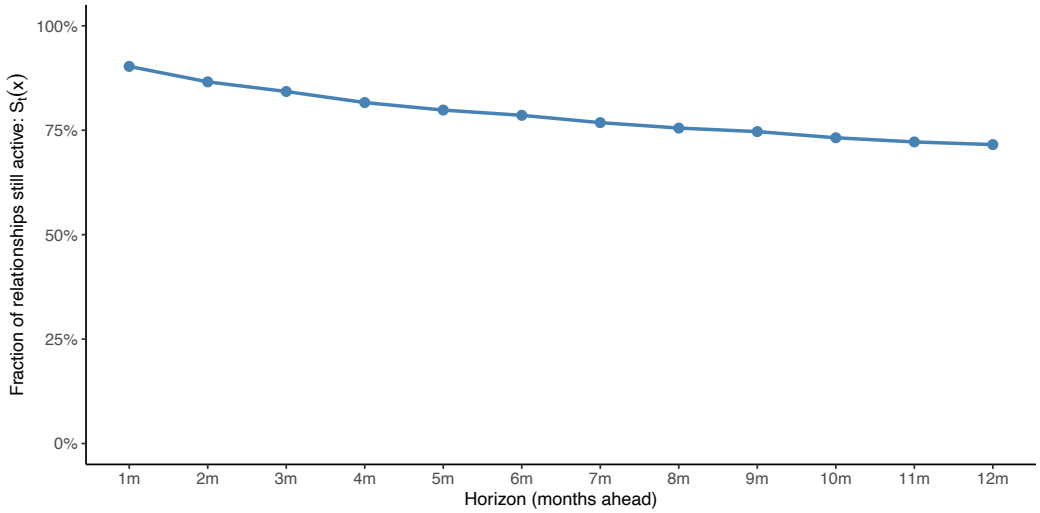
$$\hat{\alpha}_{j,t} = \frac{\underbrace{\mathbf{1}\left(month \in \{3,6,9,12\}\right)\Delta Debt_{j,t}}_{shift}\sum_{\tau}[\underbrace{\sum_{i}\theta^{Bill}_{i,\tau,t-1}\theta^{Bank}_{i,j,t-1}}_{share}]\tilde{WDIT}^{QE}_{t,\tau}}{\sum_{t,\tau}\tilde{WDIT}^{QE}_{t,\tau}{}^{2}}$$

$$\hat{\beta}_{j,t} = \frac{\underbrace{\sum_{\tau}\sum_{i}\theta^{Bill}_{i,\tau,t-1}\theta^{Bank}_{i,j,t-1}}_{share}\tilde{y}_{t,\tau}}{\underbrace{\sum_{\tau}\sum_{i}\theta^{Bill}_{i,\tau,t-1}\theta^{Bank}_{i,j,t-1}}_{share}\tilde{WDIT}^{QE}_{t,\tau}}$$

where we use $\tilde{X}$ to represent the dependent variable/regressors after teasing out the impact from the remaining covariates in equation (19)

B.4.3 Persistence of Fund–Bank Relationships

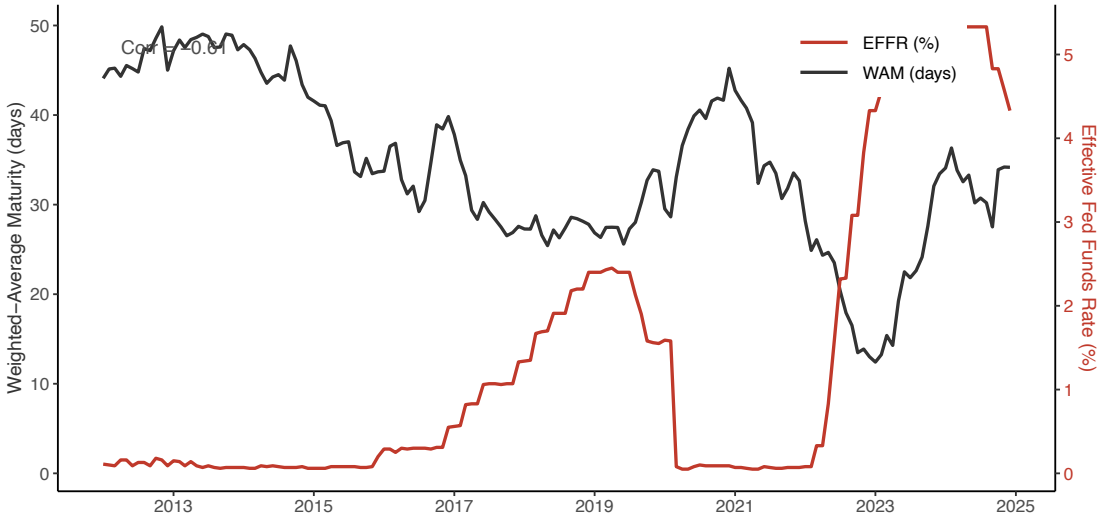
Figure B.16: Bank-Fund Relationship: Extensive Margin



Notes: This figure plots the survival rate of fund–bank relationships. It's computed as follows: for each date t, form the set of unique fund–bank pairs $\mathcal{L}_t$. For horizon x, compute the survival rate $S_t(x) = \frac{|\mathcal{L}_t \cap \mathcal{L}_{t+x}|}{|\mathcal{L}_t|}, \quad \forall t \in T$. Repeat across horizons x to trace the persistence profile of relationships.

B.4.4 Persistence of MMF's Treasury Investment

Figure B.17: MMF Portfolio Duration and Interest Rate



Notes: This figure plots the weighted average maturity (WAM) of our MMF sample and the effective federal funds rate.

B.4.5 The Overnight Reverse Repurchase (ON RRP) Facility

The Federal Reserve's overnight reverse repurchase agreement (ON RRP) facility allows eligible counterparties to place cash with the Fed overnight at a fixed rate, which puts a floor under short-term money-market rates. The Fed launched it on a test basis in September 2013. In contrast to its standing repo operations with primary dealers, the ON RRP admits a wider set of counterparties that includes money market funds, government-sponsored enterprises, and banks, with money market funds eligible from the start. The amount each counterparty can place is capped on a daily, per-counterparty basis. That cap was initially $30 billion (set in September 2014, alongside an aggregate limit of $300 billion), was raised to $80 billion in March 2021, and again to $160 billion in September 2021.

The size of this cap matters for our setting because it governs how readily a fund can substitute toward the Fed rather than toward Treasury bills. When the facility is small or its cap binds tightly, as in the early years of our sample, a fund that pulls back from bank funding at quarter-end has little to reallocate into besides Treasury bills, so the price effect

on bills is larger. Once the cap is relaxed, the ON RRP becomes an elastic place to park cash; it absorbs a larger share of the quarter-end reallocation and weakens the effect on Treasury prices. This pattern lines up with the smaller post-2015 spillover coefficient in Table 7.

B.4.6 Timing Placebo

Table B.15 reports a placebo test that shifts the quarter-end indicator one month earlier. This assigns the predicted window-dressing pressure to a month when banks do not yet face the reporting incentive. The results show no placebo effect: across all three samples, the coefficient on the placebo measure is statistically insignificant. This supports the interpretation that the baseline effect reflects actual quarter-end window-dressing pressure rather than persistent tenor differences or general pre-quarter-end Treasury-market dynamics.

Table B.15: Window-Dressing Spillovers: Timing Placebo

Dependent Variable:	$\Delta spread$		
	Full Sample	2012-2014	2015-2024
Specification:	(1)	(2)	(3)
$WDIT^{QE}$ (Placebo)	6.021	4.603	6.198
	(5.139)	(6.858)	(5.741)
Controls	Yes	Yes	Yes
YearQuarter × Maturity bucket	Yes	Yes	Yes
Report month	Yes	Yes	Yes
Observations	1,840	432	1,408
R^2	0.830	0.571	0.833
Within R^2	0.003	0.016	0.003

Notes: OLS estimates of equation (19) with the quarter-end indicator shifted one month earlier (placebo). The dependent variable, sample splits, fixed effects, control, and clustering are as in Table 7. Standard errors, clustered by year-quarter-by-maturity bucket, are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

B.4.7 Weaker Identification Assumption and Estimates

To relax Assumption 1, we construct a weaker version of $WDIT^{QE}_{t,\tau}$ that removes fund-specific Treasury-tenor exposure. Define

$$WDIT^{weak}_{t,\tau} \equiv \mathbf{1}\{month(t) \in \{3,6,9,12\}\} \sum_{i,j} \bar{\theta}^{Bill}_{\tau,t-1} \theta^{Bank}_{i,j,t-1} \Delta Debt_{j,t},$$

where $\bar{\theta}^{Bill}_{\tau,t-1}$ denotes the average lagged Treasury-bill exposure to tenor τ across money market funds, i.e., the MMF sector-level portfolio weight. Consistency now requires only the weaker assumption:

Assumption 2 *For any Treasury tenor τ and bank j in each period t, the lagged bank-fund exposure $\theta^{Bank}_{i,j,t-1}$ is orthogonal to the unobserved tenor-level price shock $\epsilon_{t,\tau}$:*

$$\mathbb{E}_{\tau,j,t}\left[\epsilon_{t,\tau}\theta^{Bank}_{i,j,t-1}\middle|\ \alpha_t,\ \gamma_{\tau,q(t)},\ X_{t,\tau}\right] = 0, \quad \forall i,j,\tau,t$$

Compared with the baseline variable, $WDIT^{weak}_{t,\tau}$ requires a weaker identifying assumption because it removes the cross-sectional variation in fund-specific Treasury-tenor allocations. In practice, this assumption is also more likely to hold. Bank-fund relationships are largely determined by persistent counterparty relationships, credit limits, and operational considerations, and therefore evolve slowly over time. By contrast, fund-specific Treasury maturity allocations are active portfolio choices that may respond to expected issuance, anticipated monetary policy, or relative-value opportunities along the Treasury bill curve. Consequently, lagged Treasury-tenor weights may still be correlated with unobserved tenor-level pricing shocks, whereas lagged bank-fund exposures are arguably much less susceptible to such concerns. By replacing $\theta^{Bill}_{i,\tau,t-1}$ with the cross-sectional average $\bar{\theta}^{Bill}_{\tau,t-1}$, the identifying variation is driven solely by predetermined bank-fund relationships rather than potentially endogenous maturity allocation decisions.

We repeat the baseline regression specifications using $WDIT^{weak}_{t,\tau}$. The results, reported in Table B.16, show that the estimated coefficient changes only negligibly, indicating that our findings are robust to the weaker identifying assumption.

Table B.16: Window-Dressing Spillovers under the Weaker Identification Assumption

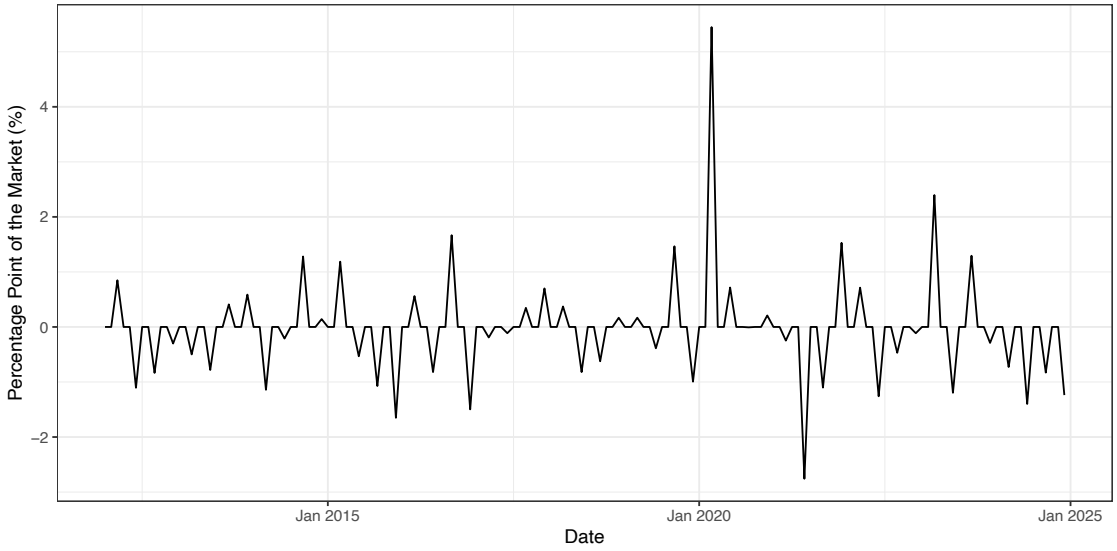
Dependent Variable:	$\Delta spread$		
	Full Sample	2012–2014	2015–2024
	(1)	(2)	(3)
$WDIT^{weak}$	3.7699**	3.0467**	4.0157*
	(1.5714)	(1.2771)	(2.0531)
Controls	Yes	Yes	Yes
YearQuarter × Maturity bucket	Yes	Yes	Yes
report_month	Yes	Yes	Yes
Observations	1,840	432	1,408
R^2	0.83119	0.58585	0.83374
Within R^2	0.00873	0.05084	0.00768

Notes: OLS estimates of equation (19). The dependent variable is the month-end change in the spread to the federal-funds lower bound, in basis points. The same short-maturity Treasury universe—nominal bills, notes, and bonds with under one year to maturity—is used to construct both $WDIT^{weak}_{t,\tau}$ and $\Delta spread_{t,\tau}$, and securities within 15 days of maturity are excluded. All specifications include report-month and year-quarter-by-maturity-bucket fixed effects and control for the bid–ask spread. Standard errors, clustered by year-quarter-by-maturity bucket, are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

B.4.8 $WDIT^{QE}_{t,\tau}$ vs $\Delta Bill^{QE}_{t,\tau}$

Figure B.18 plots the time series of the market-level difference between $WDIT^{QE}_{t,\tau}$ and $\Delta Bill^{QE}_{t,\tau}$. The figure shows that $WDIT^{QE}_{t,\tau}$ is systematically smaller in magnitude than the observed change in Treasury bill holdings, $\Delta Bill^{QE}_{t,\tau}$.

Figure B.18: Market-Level Difference between $WDIT^{QE}_{t,\tau}$ and $\Delta Bill^{QE}_{t,\tau}$



Notes: This figure plots the market-level difference between $WDIT^{QE}_{t,\tau}$ and $\Delta Bill^{QE}_{t,\tau}$

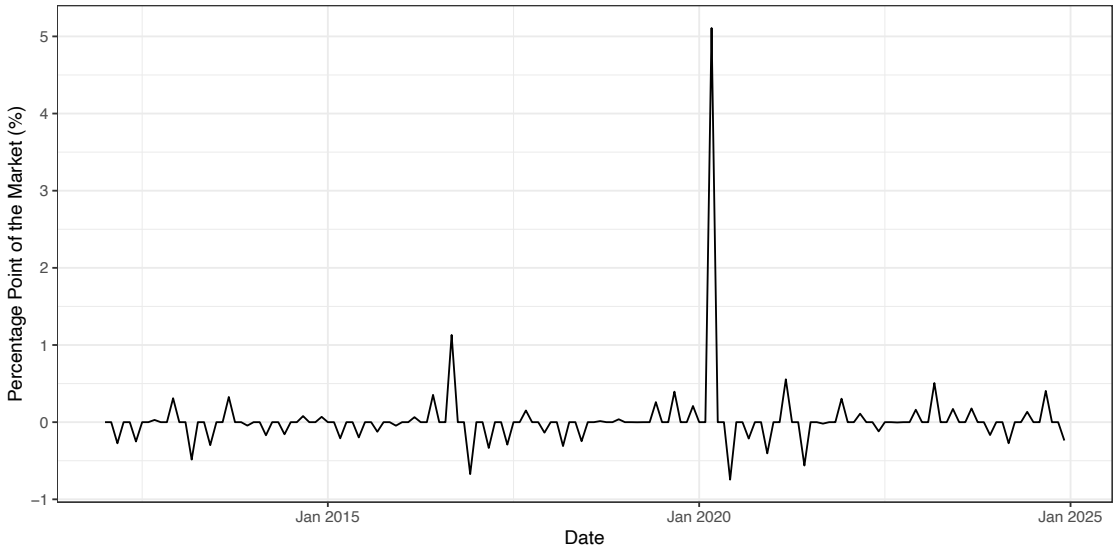
This gap is expected by construction. The measure $WDIT^{QE}_{t,\tau}$ captures only the reallocation of funds induced by quarter-end reductions in bank borrowing from MMFs. It does not capture changes in Treasury demand arising from the allocation of contemporaneous fund inflows. As documented in Section 5, MMFs are more likely to direct new fund inflows into Treasury securities at quarter-end than during other periods. Because these flow-driven portfolio adjustments are excluded from the construction of $WDIT^{QE}_{t,\tau}$, the measure captures only a subset of the total quarter-end increase in Treasury bill demand, leading it to be systematically smaller than $\Delta Bill^{QE}_{t,\tau}$. To recover the importance of this omitted flow channel, we estimate the following regression:

$$\Delta Bill^{QE}_{i,\tau,t} = \beta \times \text{NetFlow}_{i,t} + \alpha_t + \gamma_\tau + \zeta_i + \epsilon_{i,t,\tau}$$

We then use the fitted values from this regression to isolate the component of Treasury bill purchases attributable to fund inflows and remove it from the aggregate Treasury demand measure. Figure B.19 plots the difference between $WDIT^{QE}_{t,\tau}$ and the resulting adjusted

measure, $\widehat{\Delta Bill_{t,\tau}^{QE}}$. The discrepancy becomes substantially smaller. [19]

Figure B.19: Market-Level Difference between $WDIT_{t,\tau}^{QE}$ and $\widehat{\Delta Bill_{t,\tau}^{QE}}$

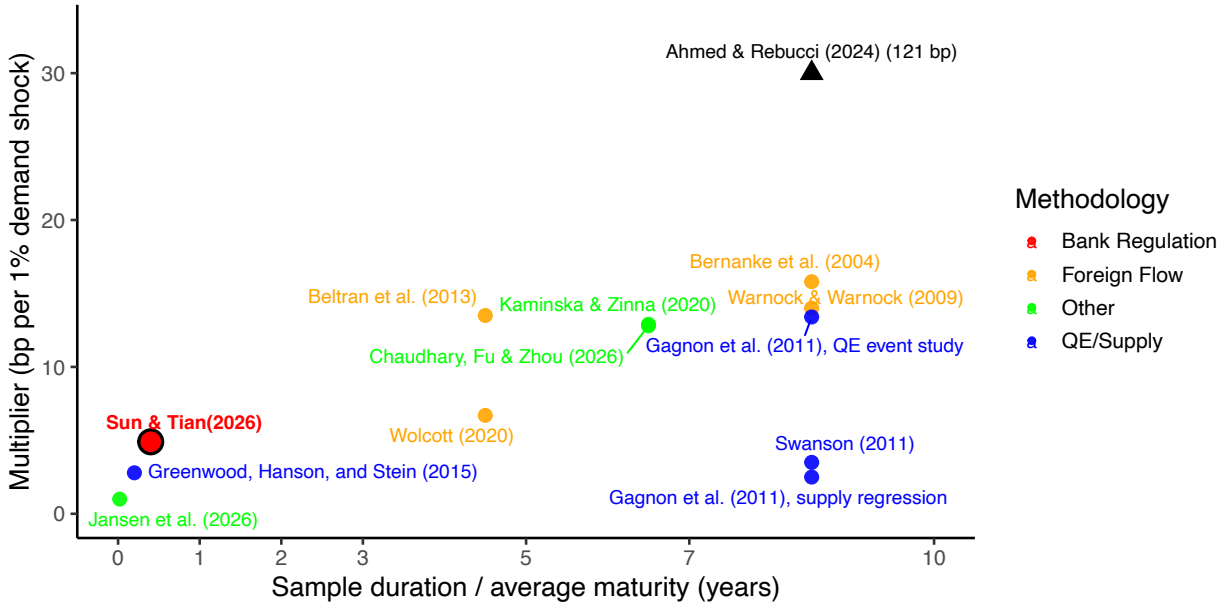


Notes: This figure plots the market-level difference between $WDIT_{t,\tau}^{QE}$ and $\widehat{\Delta Bill_{t,\tau}^{QE}}$, where $\widehat{\Delta Bill_{t,\tau}^{QE}}$ is constructed by taking out the impact from NetFlow.

Overall, this exercise suggests that our measure captures only a subset of the total quarter-end demand shock. As a result, the estimated coefficient β should be interpreted as an upper bound on the market multiplier, since the true demand shock is likely larger than the one measured by $WDIT_{t,\tau}^{QE}$.

[19] The main exception is March 2020. During the COVID-19 "dash-for-cash" episode, MMF portfolio reallocations were unusually large and abrupt, making them difficult to capture using lagged portfolio weights.

Figure B.20: Estimated Treasury Yield Multiplier in the Literature



Notes: This figure compares estimated price multipliers across studies. The horizontal axis reports the average duration or maturity of the securities studied, measured in years. The vertical axis reports the estimated yield response, in basis points, to a demand shock equal to 1% of the outstanding market value of the corresponding asset class. Estimates are rescaled to a common unit whenever necessary. Colors indicate the identification strategy employed by each study. The red marker highlights our estimate. To preserve readability, the estimate from Ahmed & Rebucci (2024) is shown separately as an annotated outlier.

B.5 Additional Results for Section 7

B.5.1 Derivation of the Per-Dollar Saving

1-dollar Treasury Bill with annualized yield y and maturity $T \equiv \frac{\tau}{365}$ has price:

$$P(y) = \frac{1}{1+yT}$$

Take f.o.c. with regards to y:

$$\frac{dP}{dy} = \frac{-T}{(1+yT)^2}$$

So a small yield change dy changes the price by:

$$dP \approx \frac{-T}{(1+yT)^2} dy$$

Given that $1/(1+yT)^2 \approx 1$ when yT is tiny, and $dy = \beta/10000$, we have:

$$\Delta P \approx T \times \frac{\beta}{10,000}$$

B.5.2 Equivalence of Supply and Demand Shocks

The spillover coefficient is identified from a *demand* shock, the quarter-end MMF reallocation, but it maps directly into the price impact of a *supply* shock. To see this, consider market clearing in tenor τ. The outstanding supply T_τ is held either by a non-MMF residual demand curve $R_\tau(\cdot)$ or by money market funds, whose holdings are $H_\tau \equiv (M-m)_\tau$:

$$T_\tau \;=\; R_\tau(r_\tau^T) \;+\; H_\tau,$$

where r_τ^T is the tenor-τ yield and $R_\tau(\cdot)$ is increasing in the yield, so a higher yield draws in more non-MMF demand.

Differentiating around the equilibrium, any change in supply or in MMF holdings must be taken up by the residual investors, which moves the yield:

$$\Delta r_\tau^T \;=\; \frac{1}{R'_\tau(r_\tau^T)} \big(\Delta T_\tau - \Delta H_\tau\big).$$

The bracketed term $\Delta T_\tau - \Delta H_\tau$ is the net quantity the residual investors must absorb: extra issuance ($\Delta T_\tau > 0$) and a withdrawal of MMF demand ($\Delta H_\tau < 0$) both raise it. The factor $1/R'_\tau$ is the inverse slope of residual demand, that is, the yield change per unit of net quantity. The key implication is that a dollar of new bill supply and a dollar of withdrawn MMF demand enter symmetrically: both are absorbed by the same residual demand curve and move the yield through the same $1/R'_\tau$.

This symmetry is what lets us reuse the spillover estimate. The quarter-end regression identifies exactly this slope from MMF demand shocks, $\hat{\lambda} \equiv \hat{\beta} = 4.9$ basis points per per-

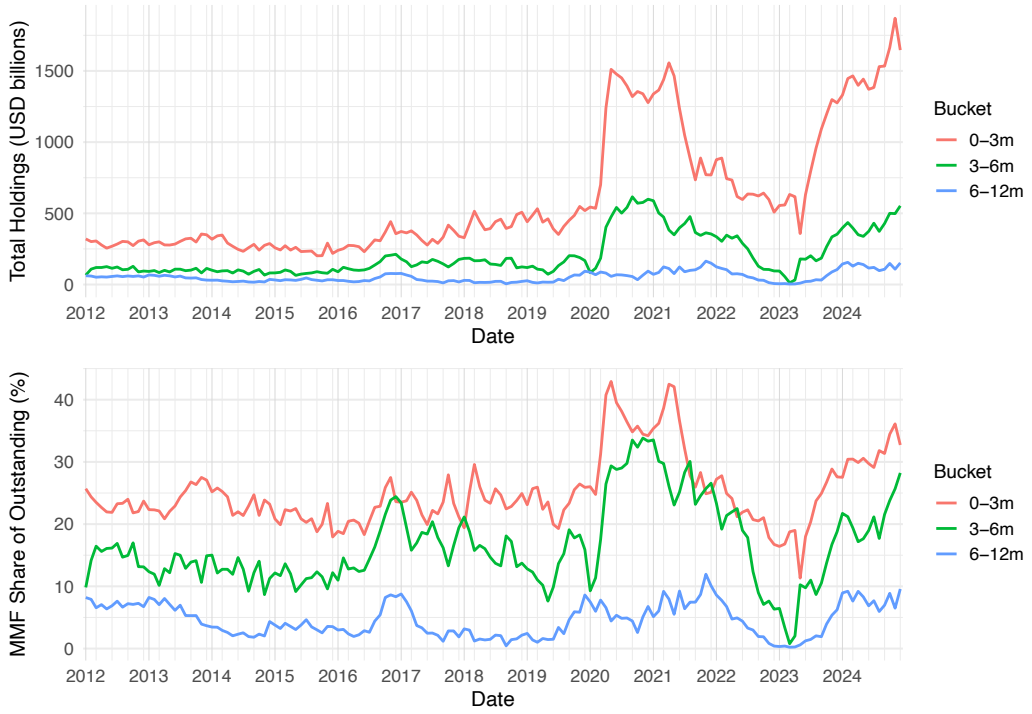
centage point of tenor market size from Table 7.[20] Applying $\hat{\lambda}$ to a supply increase, scaled by the tenor's outstanding size Size_τ and expressed in percentage points (the factor of 100), gives the predicted yield effect of new bill issuance.

B.6 Other Empirical Appendix

B.6.1 MMF holdings of Treasury

Money-fund Treasury demand is short-dated and large relative to supply: Figure B.21 shows MMF holdings concentrated in short maturities, amounting to roughly a third of marketable short-term Treasuries outstanding.

Figure B.21: MMF Holdings of Short-Term Treasury by Remaining-Maturity Bucket



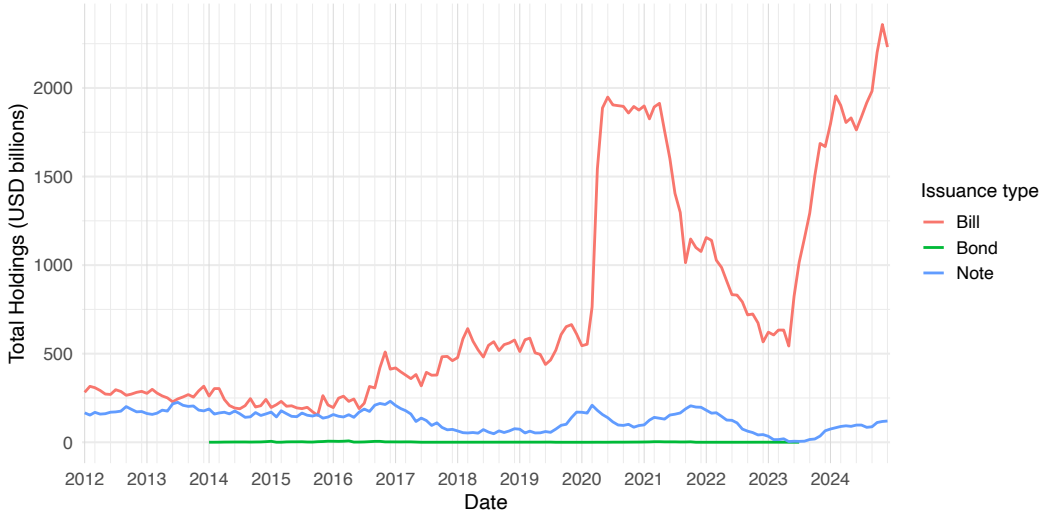
Notes: The top panel presents the dollar value of MMF holdings by remaining-maturity bucket since 2012, while the bottom panel reports these holdings as a percentage of total marketable Treasury securities outstanding.

Figure B.22 shows this demand falls predominantly on Treasury bills, the instrument into

[20] We use the preferred two-way fixed-effects estimate of the local slope, $\hat{\lambda} \approx 4.9$ bp/pp. The calibration scales linearly in $\hat{\lambda}$, so it can be rescaled to any preferred point estimate.

which freed money-fund cash is reallocated in the model.

Figure B.22: MMF Holdings of Short-Term Treasury by Treasury Issuance Type

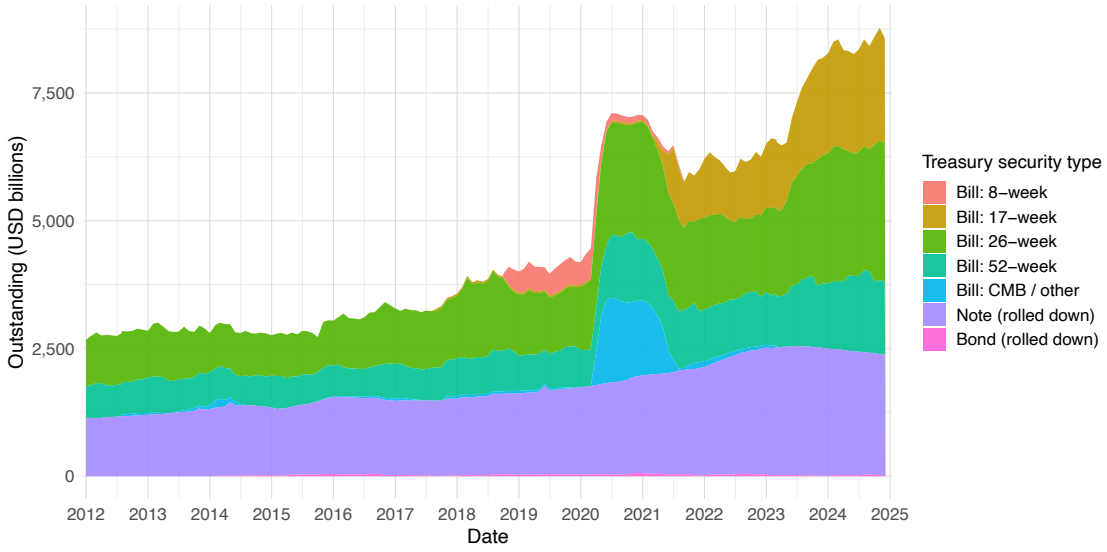


Notes: The plot presents the dollar value of MMF holdings by Treasury's issuance type.

B.6.2 Composition of the Short-Term Treasury Market

Figure B.23 plots the composition of the short-maturity Treasury universe over the sample period. Treasury bills dominate the stack at all dates, with the regular auction tenors at 4-, 8-, 13-, 17-, 26-, and 52-week maturities accounting for the bulk of outstanding face value. Cash-management bills, which the Treasury issues at irregular intervals to bridge short-term cash-flow imbalances, have grown notably since 2020 in response to pandemic-era financing needs and recurring debt-ceiling episodes. The 17-week bill is a 2022 addition to the regular auction calendar. Originally longer-maturity Treasury notes and bonds that have rolled down to within one year of maturity also contribute to the short-end universe but at substantially smaller volumes than bills. This breakdown is useful background for the empirical analysis in Sections 3 and 5, where Treasury bills are the central object of interest because they are MMFs' dominant Treasury holding.

Figure B.23: Short-Term Treasury Outstanding by Treasury Security Type



Notes: This figure plots the market value of outstanding U.S. Treasury securities with one year or less to maturity from January 2012 to December 2024, broken down by Treasury security type. Bills are bucketed by their original auction tenor (4-, 8-, 13-, 17-, 26-, and 52-week, with cash-management bills grouped as "CMB / other"). Notes and bonds that have rolled down to within one year of maturity are shown as separate categories at the top of the stack.

B.6.3 Treasury Auctions and Reopenings

This subsection summarizes the institutional features of the U.S. Treasury auction process that are relevant for the empirical analysis. Two features matter for our identification: the regular auction calendar of bills determines when new short-end supply enters the market, and the practice of *reopening* an existing security creates multiple distinct issue dates that share the same maturity date and coupon. Both features inform how we map issue and maturity records in the CRSP daily file and how we construct the auction-week issuance control in equation (2).

Regular bill auction calendar. The U.S. Treasury auctions Treasury bills on a regular schedule across six tenor buckets: 4-week, 8-week, 13-week, 17-week, 26-week, and 52-week.[21]

[21]The 17-week bill was introduced in October 2022 to fill the gap between the 13-week and 26-week tenors and is now part of the standing auction calendar. Earlier in our sample, only 4-, 8-, 13-, 26-, and 52-week tenors are auctioned regularly.

The 4-, 8-, 13-, and 26-week bills are auctioned weekly, the 17-week bill is auctioned weekly since its 2022 introduction, and the 52-week bill is auctioned every four weeks. Auction announcements typically occur a few days before the auction date, and securities are issued and delivered shortly after the auction clears. Each auction announcement specifies the security type, the offering amount, the auction date, the issue date, the maturity date, and the closing times for non-competitive and competitive bidding.

Cash-management bills (CMBs). In addition to the regular bills, the Treasury issues cash-management bills at irregular intervals to bridge short-term cash-flow imbalances around quarterly tax-receipt dates, debt-ceiling episodes, and unexpected fiscal needs. CMBs share the bill structurethey are zero-coupon, sold at a discount, and pay face at maturitybut their auction frequency, offering size, and original tenor are determined ad hoc by the Treasury. CMB issuance has expanded notably since 2020 in response to pandemic-era financing needs (see Figure B.23). In our empirical analysis we treat CMBs as part of the bill universe because they are economically equivalent to regular bills for the purposes of MMF demand.

Coupon securities and reopenings. Treasury notes (originally 2-, 3-, 5-, 7-, and 10-year tenors) and Treasury bonds (originally 20- and 30-year tenors) are auctioned monthly or quarterly depending on the tenor, with most tenors involving an initial offering followed by one or more *reopenings* of the same security in subsequent months. A reopening is an additional offering of an outstanding issue: the reopened security has the same CUSIP, maturity date, and coupon rate as the original, but a different issue date and a different auction-determined price.[22] Reopenings imply that the same CRSP issue can have multiple recorded *issuance dates* but a single *maturity date*, which we account for when constructing the auction-issuance control variable for the price regressions.

Bidding mechanism. Treasury auctions are single-price (uniform-price) auctions: all successful bidders receive the same rate, yield, or discount margin set by the highest accepted bid. Non-competitive bidssubmitted by smaller investors and capped at $10 million per auc-

[22]For a non-reopening note auction, the coupon rate is set during the auction itself at the highest 1/8-percent increment that does not produce a price greater than 100 percent of principal. Reopened notes inherit the original coupon, with only the price determined in the new auction.

tionare filled at the auction-clearing rate before competitive bids are awarded. Competitive bids submitted by institutional investors specify a maximum rate, yield, or discount margin and are awarded from lowest to highest until the offering size is filled, with each bidder limited to 35% of the offering. Pre-auction trading occurs in the *when-issued* market, which serves as a price-discovery mechanism between announcement and auction. Although when-issued trading is informative about expected auction prices, it does not enter our empirical specifications because our identifying variation comes from quarter-end demand pressure rather than pre-auction expectations.

C Data Preparation and Cleaning

We obtain money market fund (MMF) data from Form N-MFP filings available through the U.S. Securities and Exchange Commission (SEC) EDGAR database. Each submission contains information at multiple levels:

- *SUBMISSION*: This dataset identifies each N-MFP filing and related metadata, with each row corresponding to a unique fund-level submission. We remove duplicate filings, as funds may amend and resubmit reports. We also exclude funds that are liquidating or merging into other funds.

- *SERIESLEVELINFO*: This dataset contains fund-level characteristics for each submission. We extract the *seriesid*, which uniquely identifies a fund across filings. Key variables include the *percentage of liquid assets*, *fund type*, *weighted average maturity (WAM)*, *weighted average life (WAL)*, *cash holdings*, *net asset value (NAV)*, and *seven-day gross yield*. Notably, since late 2024, the reporting frequency for variables such as *percentage of liquid assets* and *seven-day gross yield* has changed to daily. To ensure consistency over time, we retain only month-end observations throughout the sample period.

- *CLASSLEVELINFO*: This dataset provides share-class-level information, where each *seriesid* may correspond to multiple *classid*s. We extract subscription and redemption flows to measure investor inflows and outflows, as well as the *seven-day net yield* to capture after-fee returns. We also use the *minimum investment threshold* as a proxy for investor type (institutional vs. retail). Similar to the fund-level data, subscriptions and redemptions are reported at daily frequency after late 2024; we again aggregate to month-end values for consistency.

- *ADVISER*: This dataset identifies each fund's investment adviser, which we use to aggregate holdings to the adviser (i.e., fund family) level. Raw adviser strings, however, are inconsistent along several dimensions: the same adviser may appear under slightly different legal names across filings, advisers may rebrand (for example, Wells Fargo Funds Management becomes Allspring Funds Management in 2021), and some series

are linked to multiple adviser strings over their reporting history, typically reflecting corporate actions rather than a genuine change of adviser. To construct a consistent adviser identifier, we first collapse the submission-level data to a series–adviser panel and identify series that report more than one adviser string over time. For each such case, we manually verify whether the multiple names correspond to a single underlying adviser or to a true change of adviser, using SEC filings and public announcements, and we assign a single consolidated adviser name to each series. We then aggregate to the adviser level, keeping only advisers with a non-trivial presence in prime or government fund segments. The final adviser panel associates each *seriesid* with a unique parent adviser entity and is used throughout the analysis whenever fund-family-level aggregation is required.

- *SCHPORTFOLIOSECURITIES*: This dataset reports each individual security held by a fund at the reporting date and is the workhorse of our holdings-based analysis. Each row corresponds to a unique fund–security–date observation. From the raw filings we retain the security identifier (CUSIP and, when available, LEI), the issuer name, the investment category (U.S. Treasury debt, U.S. Government agency debt, certificates of deposit, financial and non-financial commercial paper, repurchase agreements, variable-rate demand notes, asset-backed commercial paper, and municipal debt), the final maturity date and the maturity date used for WAM and WAL computation, the principal amount, the amortized cost, the market value, the coupon or yield, and a flag indicating whether the rate is fixed or floating. We drop securities with non-positive market value or missing issuer identifiers, and we harmonize the investment-category labels across the SEC schema revisions of 2016 and 2023. All monetary values are expressed in nominal U.S. dollars, and we compute the tenor of each security in weeks to final maturity. For repurchase agreements we additionally retain the counterparty (repo seller) identity, which is later reconciled with the corresponding records in *COLLATERALISSUERS*.

- *COLLATERALISSUERS*: For each repurchase agreement reported in *SCHPORTFOLIOSECURITIES*, this dataset contains one row per piece of collateral pledged by the

repo counterparty. Each row records the collateral issuer name and category (U.S. Treasury, Agency MBS, corporate bond, equity, and so on), the coupon and maturity of the underlying collateral, and the principal and market value pledged. Because a single repo position may be backed by many pieces of collateral, we aggregate the data to the fund–repo–date level by summing market values across rows and computing the share of each collateral category. We classify a repo as "safe-asset-backed" if its collateral consists solely of U.S. Treasury or Agency securities. The aggregated collateral information is then merged back into *SCHPORTFOLIOSECURITIES* via the repo identifier, so that every repo position in the holdings panel carries both a counterparty identity and a full decomposition of its collateral.

After cleaning each of these tables individually, we merge the submission-, series-, class-, portfolio-, and collateral-level files into a single long panel indexed by seriesid–classid–CUSIP–date. We then drop residual duplicates that arise when the same security is reported more than once within a filing, retaining the record with the largest reported market value.

Crane Data The N-MFP filings do not contain standardized issuer identifiers (such as LEIs or parent–subsidiary linkages), and fields such as principal amounts and credit ratings are unevenly populated over time. To fill these gaps we supplement the N-MFP data with proprietary data from Crane Data, a commercial provider that tracks U.S. MMFs at the share-class, fund, and security level. We aggregate the raw Crane files to a monthly, fund-level panel and use them as the primary auxiliary source for issuer identity, security-level principal, and short-term credit ratings.

Sample Restriction Our analysis focuses on prime and government MMFs, which together account for the vast majority of U.S. MMF assets and are the funds most directly exposed to bank debt and short-term Treasury securities. We therefore restrict both the N-MFP and Crane panels to prime and government funds using a consistent fund-type classification.

Issuer Identity The issuer names reported in N-MFP filings are inconsistent across time and across funds. For example, the same bank may appear as "JPM," "JPMorgan," "JP

Morgan Chase & Co.," or "JPMorgan Chase Bank, N.A." across different filings. To harmonize these strings, we exploit the fact that Crane maintains a cleaned issuer taxonomy with parent–subsidiary linkages. We first construct a crosswalk between raw Crane issuer strings and a unified "issuer identity" at the parent-entity level. We then fuzzy-match the N-MFP issuer strings to this crosswalk, allowing for common misspellings, abbreviations, and punctuation differences, and manually verify ambiguous cases. The resulting issuer identity is assigned to each unsecured holding (commercial paper, certificates of deposit, time deposits, and other bank debt) and to the counterparty of each repurchase agreement. This harmonization is essential for constructing fund–bank exposure measures and the Bartik instrument described in Section 6.

Principal A first-order data issue is that, following the SEC's 2014 money market fund reforms, whose amendments to Form N-MFP took effect on April 14, 2016, many MMFs ceased to report security-level principal amounts to the SEC, and the principal field becomes systematically missing for a large share of holdings beginning in early 2016. This break in coverage makes it impossible to measure changes in security-level holdings consistently over time using the N-MFP data alone. Crane Data, however, reconstructs principal at the security level by collecting the underlying information directly from each fund's website and shareholder portal, and reports principal on a continuous basis throughout our sample period. We therefore build a security-level principal crosswalk from Crane and merge it back to the cleaned N-MFP holdings panel using the combination of issuer identity, investment category, coupon, and maturity date as the matching key. For the residual set of holdings without a Crane match, we back out the principal from the reported market value, coupon, and time to maturity using a standard zero-coupon or coupon-bond pricing formula, depending on the security type.

Credit Ratings Short-term credit ratings are reported unevenly across issuers and time in the N-MFP filings and are not mandatory fields after 2023. We therefore rely on Crane, which consolidates short-term ratings from Moody's, S&P, and Fitch at the issuer level. We construct an issuer-level rating crosswalk and attach the relevant short-term rating to each N-MFP holding using issuer identity and the filing date, retaining the most recent rating

available prior to the reporting date. For issuers rated by multiple agencies, we preserve each agency's rating separately and, where necessary, map the alphanumeric scales to a common ordinal index.

The resulting dataset is a monthly, fund–security-level panel covering prime and government MMFs from 2012 to 2024, in which each holding carries a harmonized issuer identity, a cleaned principal amount, and issuer-level short-term credit ratings. This panel serves as the basis for the portfolio-allocation and window-dressing analyses presented in the main text.