The U.S. Treasury floating rate note puzzle: Is there a premium for mark-to-market stability?

Online Appendix

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A.1 Data Sources

Table A1 provides a description of the data and variables used in the study along with their definitions and corresponding sources for the data.

A.2 The U.S. Treasury Floating Rate Note Market

The U.S. Treasury floating rate note (FRN) market had its inception in January 2014. FRNs are issued with a maturity of two years and their coupon cash flows are indexed to the most recent 13-week Treasury bill auction high rate plus a constant spread (for details, see https://www.treasurydirect.gov/instit/marketables/frn/frn.htm). The Treasury auctions FRNs every three months in January, April, July, and October, and reopens each FRN issue in the two subsequent months after original issuance. When a FRN is reopened, it has the same maturity date, spread, and coupon dates as the original issue, but a different issue date and issue price. Original issue offerings are issued on the last calendar day of a month, or the first business day thereafter. Reopening offerings are issued on the last Friday of a month, or the first business day thereafter.

Similar to Treasury notes, FRNs are auctioned using a single-price auction mechanism in which each competitive bidder specifies a discount margin, expressed in tenths of a basis point, which can be positive, zero, or negative. The Treasury first accepts in full all noncompetitive tenders up to $5 million per sub-

mitter. The Treasury announces its auction schedule at https://www.treasurydirect.gov/instit/instit.htm?upcoming. Competitive tenders are accepted in order of discount margin, from the lowest discount margin to the highest discount margin at which the quantity of awarded bids reaches the offering amount. The Treasury awards FRNs to both noncompetitive and competitive bidders at the price equivalent to the highest accepted discount margin at which bids were accepted. Thus, all bidders receive the same discount margin at the highest accepted bid. For example, if 80.15 percent is the announced percentage at the highest discount margin, the Treasury awards 80.15 percent of the amount of each bid at that discount margin. The usual Treasury proration rules apply if the amount of tenders at the highest accepted discount margin exceeds the amount of the remaining offering amount. The Treasury's auction rules are available at https://www.treasurydirect.gov/instit/statreg/auctreg/auctreg.htm.

FRNs pay quarterly coupon cash flows on the last calendar day of the month from the dated date to and including the maturity date. The dollar amount of the coupon payment is the cumulative total of daily interest which accrues at a rate equal to the most recent 13-week Treasury bill auction high yield plus a spread which is determined at the initial auction. The spread on a FRN at the initial auction is set at the highest accepted discount margin in that auction, and when a FRN is reopened, the spread remains equal to the spread set at the initial auction. The daily interest accrual rate is floored at zero percent. FRNs are redeemed at their par amount at maturity.

For a given day t, let r_t denote the 13-week Treasury bill auction high yield from the last Treasury bill auction at least two business days prior to day t (expressed as a money-market equivalent yield). Let S denote the spread on a FRN which is determined at the initial auction and expressed in tenths of a basis point. The conversion formulas are published in the Treasury's Uniform Offering Circular at https://www.treasurydirect.gov/instit/statreg/auctreg/2013-18178.pdf. On each day, accrued interest per dollar of par amount is $\max\left[0, (r_t + S)/360\right]$. When the auction rate from the most recent 13-week Treasury bill auction becomes effective within two business days of a coupon date (lock-out period), then

interest on the days prior to the coupon payment accrues at the auction rate from the auction prior to the start of the lock-out period. Each accrual period is from and including the last coupon cash flow date (or the dated date) to, but excluding the next coupon payment date (or the maturity date). FRNs follow the actual/360 daycount convention. The dated date is always the last calendar day of a month.

The first Treasury FRN was auctioned on January 29, 2014 and issued on January 31, 2014. The size of the FRN market has grown significantly since its inception. As of the end of March 2018, the total FRN dollar amount outstanding was $334 billion which represented 2.28 percent of total marketable Treasury debt, 3.75 percent of total Treasury notes, and 16.07 percent of the total amount of Treasury bills outstanding. The total par amount of FRNs issued from the inception of the market through March 2018 was $720.969 billion. Table 3 of the paper shows the total par amount for each of the FRN issues auctioned through March 2018. These data are from SIFMA at https://www.sifma.org/resources/research/us-marketable-treasury-issuance-outstanding-and-interest-rates/.

A.3 The Basis Swap Market

In a standard interest rate swap, counterparties exchange a stream of quarterly floating payments tied to three-month Libor for a stream of fixed semiannual payments. In many cases, however, a counterparty may prefer floating rate payments to be linked to a different index than three-month Libor. Rather than introducing fixed-for-floating swaps using a variety of floating indexes (which would likely be far less liquid than a standard swap), an important side market has emerged which is known as the basis swap market. In a basis swap, counterparties exchange one stream of floating cash flows for another stream of floating cash flows. For example, in a three-month/six-month Libor basis swap, a counterparty pays three-month Libor quarterly in exchange for receiving six-month Libor semiannually (plus a fixed basis swap spread). Combining a three-month/six-month Libor basis swap with a standard interest rate swap

results in a structure with the same cash flows as if the original floating coupon payments for the interest rate swap were tied to six-month Libor. The basis swap market allows counterparties to exchange streams of floating cash flows tied to any of the following indexes: one-month Libor, three-month Libor, six-month Libor, the Treasury bill rate, the overnight index swap rate (OIS), the prime rate, and others.

A Treasury bill basis swap is a floating-for-floating exchange of (netted) cash flows where the quarterly cash flows on both legs reference a distinct floating rate index. One leg of the basis swap pays a quarterly floating cash flow of X_t based on the Treasury bill secondary market rate, plus a market-determined basis swap spread B. The value of X_t is based on the arithmetic average of the daily 13-week Treasury bill secondary market rate during the quarter. The floating cash flow X_t plus B is paid at time t at the end of the quarter over which X_t is calculated. The other leg of the basis swap pays quarterly cash flows based on the three-month Libor rate L_t set at the beginning of the quarter, but is paid at the end of the quarter. Both legs of the swap pay cash flows on an actual/360 daycount basis. The reason for the market-determined basis swap spread B is that the present values of the streams of floating cash flows from the two legs of the swap may be different. To set the present values of the two legs equal to each other, the basis swap requires that one leg of the swap pay a fixed basis swap spread B in addition to the floating cash flows.

Market prices in the basis swap markets are quoted in terms of the basis swap spread. To illustrate, the basis swap spread for a 13-week Treasury bill/three-month Libor basis swap with a two-year horizon was 41.59 basis points on February 23, 2018. Thus, a counterparty in this basis swap would pay quarterly floating payments based on the 13-week Treasury bill rate plus a fixed spread of 41.59 basis points, and receive quarterly floating payments based on the three-month Libor rate. Table A2 reports summary statistics for the 13-week Treasury bill/three-month Libor basis swap spreads for various tenors. For comparison, Table A3 reports summary statistics for the swap rates for the standard Libor swaps used in the replicating portfolios for the same tenors.

A.4 Replicating Treasury FRNs with Treasury Notes

We use a simple three-step approach in replicating the cash flows of a FRN using a two-year Treasury note. First, we use a standard interest rate swap to convert the fixed coupon cash flows from the Treasury note into floating cash flows based on the three-month Libor rate. Second, we use a basis swap to convert the resulting Libor cash flows into a stream of floating coupon payments based on the 13-week Treasury bill rate. Third, we use a series of Treasury STRIPS to match exactly the small fixed spread associated with the FRN. The net cash flows of the combined position in the two-year Treasury note and other components of the strategy replicate the cash flows that the investor receives from a Treasury FRN.

Table A4 illustrates the cash flows from creating a synthetic FRN that replicates a two-year Treasury FRN. In this example, C denotes the semiannual coupon of a matched-maturity Treasury note. F denotes the semiannual fixed coupon cash flow of a standard interest rate swap with the same maturity date as the Treasury FRN. The quarterly payment on the interest rate swap L_t equals the Libor rate times the actual/360 daycount fraction for the quarter, where the Libor rate is set at the beginning of the quarter in which this cash flow is paid. For the basis swap, the quarterly cash flow X_t is the average 13-week Treasury bill rate times the actual/360 daycount fraction for the quarter, where X_t is averaged over the quarter in which this cash flow is paid. The quarterly cash flows B and S denote the basis swap spread and the FRN spread, respectively, and are based on the annualized values for these spreads times the actual/360 daycount fraction for the quarter in which they are paid.

The first column in Table A4 shows the cash flows from buying a two-year Treasury note. The initial cash outflow paid for the note is based on the market price P_N. The note pays fixed semiannual coupons of C and pays the par amount of 100 at maturity. The second column shows the cash flows of a standard interest rate swap. The initial cash flow for the swap is zero. The third column shows the cash flows from a basis swap. The initial cash flow for this

swap is again zero. The fourth column shows the cash flows from a portfolio of Treasury STRIPS with the indicated par amounts and maturities. The market price of this portfolio of STRIPS is denoted ϵ. As shown in the fifth column, the future net cash flows from the synthetic FRN created by the replicating strategy are identical to those of the actual Treasury FRN shown in the last column. The difference between the price of the Treasury FRN, P_{FRN}, and the value of the replicating portfolio, $P_N + \epsilon$, is the price premium. The premium is computed by converting the price premium into basis points as described in the paper. Table 4 in the paper presents a specific numerical example illustrating the replicating strategy for a two-year FRN.

Although simple, the replicating strategy requires us to take several institutional details and market conventions into account. First, since the floating Treasury bill leg of the basis swap is indexed to the Treasury bill yield in the secondary market, and since the Treasury bill cash flows for the FRN are indexed to the most recent Treasury bill auction high yield, we make a small adjustment to the basis swap spread. Specifically, the quarterly FRN coupon cash flows are the cumulative total arithmetic sum of daily accrued interest calculated from the most-recent 13-week Treasury bill auction high rate. The quarterly cash flows on a Treasury bill basis swap, however, are calculated by accruing daily simple interest using the 13-week Treasury bill secondary market rate. Thus, the two Treasury bill indexes are slightly different. We verify, however, that the differences between the auction high rates and the secondary market Treasury bill rates are on the order of a small fraction of a basis point. Specifically, the average weekly difference between the most-recent Treasury bill auction high yield and the secondary market yield for the 2009–2013 pre-sample period is only 0.226 basis points in money market terms. Although very small, we adjust the Treasury basis swap rate by this difference. Using alternative pre-sample windows has virtually no impact on our results.

Second, the replicating procedure illustrated in Table A4 is straightforward to apply when the maturity of the Treasury FRN is an integral multiple of a semiannual period. For other maturities, however, we need to make a slight ad-

justment for the stub period using a simple interpolation procedure. One reason for this is the lookback accruals for the floating indexes L_t and X_t. To make this interpolation as accurate as possible, however, it is useful to first re-express the semiannual fixed cash flows in the replicating portfolio as quarterly cash flows. This re-annuitization is done by calculating the stream of quarterly fixed cash flows that has the same present value as the original stream of semiannual fixed cash flows using the discount function computed from general collateral Treasury repo rate and Treasury STRIPS data (see Liu, Longstaff, and Mandell (2006)). This conversion allows us to interpolate all cash flows on a quarterly basis, but has no effect on the values of the various components of the replicating portfolio.

To illustrate the interpolation methodology, consider a 13-month Libor interest rate swap, paying quarterly, in conjunction with a 13-month Treasury bill basis swap. Clearly, the combination of these two swaps is equivalent to a single swap exchanging quarterly fixed cash flows, say H, for floating cash flows based on the average 13-week Treasury bill rate averaged over the quarter, X_t. This composite 13-month swap has five cash flows at times $t = 0.08, 0.33, 0.58, 0.83, 1.08$. Next, consider taking an analogous position in a composite 12-month Libor/basis swap. In the 12-month swap, we make four payments X_t at times $t = 0.25, 0.50,$ $0.75, 1.00$ and receive four fixed cash flows. Similarly, in a composite 15-month Libor/basis swap, we make five payments X_t at times $t = 0.25, 0.50, 0.75, 1.00, 1.25$ and receive five fixed cash flows. Since the market-determined fixed cash flows on the 12-month, 13-month, and the 15-month swaps may differ, we denote these fixed cash flows by $H(12)$, $H(13)$, and $H(15)$, respectively.

Neither the 12-month nor the 15-month swap has time $t = 0$ cash flows. Instead, suppose we have a modified 12-month swap in which we exchange cash flows at time zero. Specifically, at time $t = 0$, we pay $X_{0.00}$ (the average Treasury bill rate over the prior three months) and receive the spread $\hat{H}(12)$. This swap has five cash flows at times $t = 0.00, 0.25, 0.50, 0.75, 1.00$ months. Thus, the 13-month swap is a five-payment swap with the first cash flows at time $t = 0.08$. The 15-month swap is a five-payment swap with the first cash flow at time $t = 0.25$ and the modified 12-month swap is a five-payment swap with first cash flow at

time $t = 0$. In order to find $H(13)$, we interpolate between $\hat{H}(12)$ and $H(15)$. The spread $\hat{H}(12)$ is determined by setting the present values of cash flows from the 12-month and modified 12-month swaps equal to each other. The spread $\hat{H}(12)$ is

$$\hat{H}(12) = \frac{(L_{0.00} - X_{0.00}) + H_{12}\left(D(0.25) + D(0.50) + D(0.75) + D(1.00)\right)}{1 + D(0.25) + D(0.5) + D(0.75) + D(1.00)},$$

where $D(t)$ denotes the discount factor for times $t = 0.25, 0.50, 0.75, 1.00$ years. The stub adjustments for other swap tenors are analogous.

A.5 Replicating Treasury FRNs with Treasury Bills

The process of replicating the cash flows from a Treasury FRN using Treasury bills is very similar to that described in the previous section. To illustrate the approach, we consider the case of a Treasury FRN with 12 months to maturity. In this case, there are market prices for 3-, 6-, 9-, and 12-month Treasury bills. We denote these prices as $P(0.25), P(0.50), P(0.75)$, and $P(1.00)$, respectively. Without loss of generality, we assume that all Treasury bills are normalized to have a one dollar notional value.

Now consider an investor who purchases the portfolio of Treasury bills shown in the first column of Table A5. Analogous to the example in Table A4, the investor executes a standard Libor interest rate swap and a Treasury bill basis swap. The only difference is that the replicating portfolio no longer needs to take a small position in Treasury STRIPS to match the spread on the FRN since the individual Treasury bills play the same role in this approach. As in the previous section, we define the FRN price premium relative to Treasury bills as the price difference between the actual Treasury FRN and the price of the replicating portfolio. The resulting price premium is then converted into a basis point premium in the same way as described above.

Table A6 presents a specific numerical example of replicating the cash flows

from a 12-month FRN using a series of Treasury bills. The FRN price premium relative to Treasury bills is 15.19 cents, which maps into a premium of 15.42 basis points.

A.6 The SEC Money Market Reform

In response to disruptions in the money market during the 2008 financial crisis when the Reserve Primary Fund "broke the buck," the SEC announced amendments to Rule 2a-7 of the Investment Company Act of 1940 on July 12, 2014 which were set to take effect on October 14, 2016 after a two-year transition period (see Money Market Fund Reform; Amendments to Form PF: Final Rule, Securities and Exchange Commission, 79 Fed. Reg at 47,736 (14 August 2014), Section III.N). Under the new rules, some money market funds (MMFs) are required to impose mandatory redemption restrictions on investors, i.e. to "gate" withdrawals, and to charge a liquidity fee if their holdings of liquid assets (assets that can be converted to cash within five business days or less) falls below a required threshold. In addition, some MMFs are no longer allowed to report a stable $1.00 per share net asset value (NAV). Instead, these MMFs became floating NAV MMFs which means that their prices fluctuate as the value of their portfolio holdings changes.

It is significant that MMFs are affected differently by the new MMF requirements depending on the types of assets they hold in their portfolios. The MMF Reform can be viewed as having created three distinct categories of MMFs: government, retail, and institutional. To be classified as a government MMF, MMFs are required to invest at least 99.50 percent of their total assets in cash, U.S. government securities and/or repurchase agreements that are collateralized fully by cash or government securities (a government security is defined as a security backed by the full faith and credit of the U.S. government (Rule 2a-7(a)(17); section 2(a)(16))). A key feature of government MMFs is that they are not subject to the mandatory fees, gates, and floating NAV requirements imposed by the reforms on other MMFs.

It is industry practice to differentiate between government treasury and government agency MMFs. The former invest solely in securities issued by the U.S. Treasury and thus meet the SEC's 99.50 percent threshold. The latter also invest in securities issued by government agencies and thus meet the 99.50 percent requirement only if they do not hold more than 0.50 percent in agency securities that are not guaranteed by the full faith and credit of the federal government. We note that certain issuers of U.S. government securities, e.g., government-sponsored enterprises such as Fannie Mae, Freddie Mac, and the Federal Home Loan Banks, are sponsored or chartered by Congress, but their securities are neither issued by nor guaranteed by the U.S. Treasury, so they do not qualify as a government security in the sense of MMF Reform.

Retail MMFs are only available to retail investors (retail MMFs must have policies and procedures reasonably designed to limit all beneficial owners of the MMF to natural persons). Retail MMFs can be further divided into prime and tax exempt MMFs. Prime MMFs invest in high-quality commercial paper, certificates of deposit, bankers' acceptances, and repurchase agreements collateralized by such securities, but can also hold short-term securities issued by the U.S. Treasury and agencies. Tax-exempt MMFs invest in municipal debt securities that pay interest that is not taxed by the federal government, and in some cases state and municipalities. Institutional MMFs can also be divided into prime and tax exempt MMFs, but their beneficial owners include, but are not limited to, defined benefit plans, endowments and foundations, corporations, and retirement savings trusts.

In contrast to government MMFs, both retail and institutional MMFs now face new rules and more stringent requirements. In particular, investors in retail and institutional MMFs face a greater risk of not being able to redeem shares at a fixed NAV of $1.00 per share than before the MMF Reform. This is because both retail and institutional MMFs are now subject to gating restrictions and liquidity fees that are triggered based on a MMF's liquid assets.

Specifically, SEC Rule 2a-7(g)-(j) defines two types of liquid assets, daily

and weekly, corresponding to the ability to convert to cash within one or five business days, respectively. Daily liquid assets are cash, direct obligations of the U.S. government, securities that will mature or are subject to a demand feature that is exercisable and payable within one business day, and receivables scheduled to be paid within one business day. At least ten percent of a MMF's total assets must qualify as daily liquid assets. Weekly liquid assets are cash, U.S. Treasury securities, and certain other government agency securities with remaining maturities of 60 days or less, or securities that will mature or are subject to a demand feature that is exercisable and payable within five business days, and receivables scheduled to be paid within five business days.

Retail and institutional MMFs are required to impose a one-percent fee on the NAV of investor shares when weekly liquid assets fall below ten percent of total assets. The MMF's management, however, also has certain discretion to impose up to a two-percent fee when weekly liquid assets fall below 30 percent of total assets. Moreover, a MMF's board may impose a temporary suspension of redemptions for up to ten business days in any 90-day period if the MMF's weekly liquid assets fall below 30 percent of total assets. MMFs are required to report weekly liquidity percentages to provide transparency to investors if there is the potential for a fee or gate.

In addition to fees and gates, institutional MMFs are no longer allowed to report a stable $1.00 per share NAV. Instead, they became floating NAV MMFs. Specifically, institutional MMFs are required to sell and redeem shares based on the current mark-to-market value of the securities in their underlying portfolios rounded to the fourth decimal place (e.g., $1.0000), i.e., transact at a floating NAV. As a result, the NAV can fluctuate, or float. In contrast, retail MMFs are still allowed to round up their NAV to $1.00 provided that the amortized cost per share is greater than or equal to $0.9950. Floating NAV requirements create significant complications for investors who use these MMFs to manage their short-term liquidity needs since they may no longer be able to redeem their shares instantaneously. For example, the SEC recognizes that since it may take several hours to strike a market-based NAV price, floating NAV MMFs may no

longer be able to offer trading times for same day settlement late in the day, i.e., after 4 p.m. (see Money Market Fund Reform; Amendments to Form PF, Investment Company Act Release No. 31166 (July 23, 2014), pp. 192-193).

Finally, as a result of the reforms, all MMFs are now subject to more stringent constraints on their portfolio holdings and to enhanced stress-testing and reporting requirements. It is important to note that even before the 2014 reform, SEC Rule 2a-7(c)(2) required that MMFs not acquire any security with a remaining maturity greater than 397 days, that the dollar-weighted average maturity of the securities owned by the MMF may not exceed 60 days, and that the MMF's dollar-weighted average life to maturity may not exceed 120 days. However, the MMF Reform also introduced new requirements for daily and weekly liquid assets and concentration limits on portfolio holdings.

Specifically, institutional and retail MMFs are required to test their ability to maintain weekly liquid assets of at least ten percent of total assets under specific stress scenarios which include increases in the level of short-term interest rates, the downgrade or default of particular portfolio security positions, a widening of spreads in various sectors to which the MMF's portfolio is exposed, each in combination with various increases in shareholder redemptions. Since 2010, when a MMF's daily liquid assets drop below ten percent of total assets, the MMF (other than municipal MMFs, which are exempt from this requirement) is prohibited from acquiring any new asset other than daily liquid assets. Similarly, if weekly liquid assets drop below 30 percent of total assets, the MMF cannot acquire any new asset other than a weekly liquid asset. Moreover, government MMFs are required to test their ability to keep a stable NAV, and prime MMFs are required to minimize principal volatility in response to the specified stress events.

In addition to making the stability of NAVs subject to stress tests, Rule 2a-7 also includes certain procedural standards overseen by the MMF's board of directors. These include the requirement that the MMF calculate the market-based value of the portfolio ("shadow price") periodically and compare it to the

MMF's stable share price. If the deviation between these two values exceeds 50 basis points, the MMF's board of directors must consider what action, if any, should be taken by the board, including whether to re-price the MMF's securities above or below the MMF's $1.00 share price. Specifically, the MMF Reform requires government MMFs to publicly disclose when their current NAV per share deviates downward from its intended $1.00 stable price by more than 25 basis points (i.e., generally below $0.9975). Form N-CR Part D, states that the disclosure requirement is triggered "[if] a retail money market fund's or a government money market fund's current net asset value per share deviates downward from its intended stable price per share by more than 1/4 of 1 percent [...]." In turn, for each day the MMF's current NAV is below this threshold, a MMF must disclose the following information: (i) the date or dates on which such downward deviation exceeded 1/4 of 1 percent; (ii) the extent of deviation between the MMF's current NAV per share and its intended stable price; and (iii) the principal reason or reasons for the deviation, including the name of any security whose market-based value or sale price, or whose issuer's downgrade, default, or event of insolvency (or similar event) has contributed to the deviation.

The MMF Reform not only had substantial implications for the MMFs themselves, but also for many investors who held MMFs for their price stability and liquidity—MMFs had previously maintained a stable $1.00 NAV and were redeemable on demand. Investors started to vote with their feet and withdrew $404.3 billion in assets, or 29.2 percent, from prime institutional MMFs, and moved $432.8 billion, or 42.8 percent, into government MMFs between October 2015 and May 2016 (see Crane Data, Money Market Funds News, 08/02/2016, www.cranedata.com). Investors withdrew an additional $500 billion from prime MMFs in the summer months prior to October 2016. "The steady, persistent trickle of redemptions turned into a flood as the October 14 deadline for compliance with the new rules approached. [...] More than $500 billion was withdrawn from prime funds over the summer including an eye-popping $250 billion in September alone" (see Faye Kilburn and Robert MacKenzie Smith, How Banks Weathered the Money Market Storm, Risk.net, 10/17/2016).

There are several reasons why MMF investors not only demand liquid, money-like investments, but view price stability as a key characteristic driving their investment decisions. "Others are more direct: if treasurers can no longer redeem daily at par, then they'll stop using them. If the stable-NAV basis were to disappear and capital was put at risk, we'd certainly stop investing in them, and I suspect many other corporates would too, says John Jackson, group treasurer for The Weir Group, a Glasgow-based engineering company" (see Tom Newton, Corporate Cash Seeks New Home as Money-Market Reforms Loom, Risk.net, 04/29/2013). Many firms use MMFs to manage their short-term liquidity needs. Gates and fees raise the prospect of failing to meet short-term funding needs and by investing in prime MMFs, firms risk that they cannot redeem their shares instantaneously. This is because prime MMFs strike multiple NAVs during the day and firms must consider the MMF's schedule and time their redemptions according to when they need liquidity. Moreover, floating NAVs complicate accounting for short-term investments since they are marked to market with gains and losses flowing through to earnings.

Many investors also face institutional constraints that prevent them from holding shares in floating NAV MMFs. For instance, public agencies may be required by their investment policy to only hold MMFs that maintain a stable $1.00 NAV per share. "... If the policy authorizes an investment in mutual funds, it shall indicate whether the authorization is limited to securities whose intention is to maintain a net asset value of $1.00 per share or also includes securities whose net asset value per share may fluctuate on a periodic basis" (see Michigan Department of Treasury, Public Act 196 of 1997, Amendments to Public Act 20 of 1943, Basic Investment Policy, March 1998). Moreover, local government investment pools (LGIPs) may be required to invest only in MMFs designated "AAAm" by Standard and Poor's (S&P) Principal Stability Rating Guidelines (PSFR) which is assigned to MMFs whose investment policies are consistent with providing a stable NAV. For instance, the Commonwealth of Pennsylvania Treasury Investment Policy mandates the fund "Pool 99" to invest in MMFs rated AAAm or its equivalent. In addition, the investment policy

requires Pool 99 to maintain a stable NAV per share of $1.00, to calculate the value of a share in Pool 99 daily, incorporating all realized and unrealized gains and losses, and any cash returned from investments, and to notify the Treasurer or designee(s) at any time the value of one share in Pool 99 declines to or below a rounded value of $0.9985 or exceeds $1.0015 (see Commonwealth of Pennsylvania Treasury Investment Policy, Effective February 19, 2014).

New regulations introduced by Basel III and the Dodd-Frank Act also increased demand for MMFs from many investors including asset managers and private equity firms. This is because many banks substantially tightened short-term funding by cutting back or even exiting the cash management business as a result of the Basel III liquidity coverage ratio (LCR) and net stable funding ratio (NSFR) requirements (see Tom Newton, Corporate Cash Seeks New Home as Money-Market Reforms Loom, Risk.net, 04/29/2013). Specifically, under Basel III liquidity requirements, for deposits designated as non-operational, the incoming cash is considered "fast outflow money" subject to withdrawal from the banks in the event of a liquidity crisis. As a result, banks are required to finance high quality liquid assets (HQLA) against these cash positions. In other words, for every dollar in short-term deposits a bank holds, it will be required to hold one dollar in HQLA which means that banks are required to put aside additional lower yielding HQLA in order to support deposits from asset managers.

In summary, a major consequence of the SEC's MMF Reform is that MMFs now have significantly greater incentives to invest in securities that minimize the potential variation in their NAVs. In turn, this provide a strong motivation for MMFs to hold FRNs in their portfolios because of the mark-to-market stability of FRN prices.

A.7 Evaluating Alternative Explanations

This section provides additional details for some of the robustness checks presented in Section 11 of the paper.

A.7.1 Robustness to Swap Mispricing

To test whether the estimated FRN premia might be driven by the basis swap and/or interest rate swap data we use in swapping fixed cash flows into floating, we apply our methodology to two alternative classes of floating rate notes. We use two sets of securities to show that neither the Treasury bill basis swaps nor the plain-vanilla Libor interest rate swaps are driving the near-money premium in FRN prices.

The first class of securities consists of pairs of floating/fixed rate corporate notes. The floating rate cash flows on corporate floating rate notes are based on three-month Libor rates. We apply the same Libor interest rate swaps to the corporate fixed coupon notes and swap these notes into floating. Analogous to how we compute FRN premia, we then compare the yields of the swapped fixed rate notes to the yields of matched floating rate notes from the same firm that have the same maturity as the swapped fixed rate note. Finding no evidence of statistically significant premia would suggest that the standard Libor interest rate swaps we use in our main analysis are not driving the results.

The data on floating and fixed rate corporate debt consist of 38 matched-maturity pairs of two-year floating/fixed rate corporate notes during the 2014 to 2018 period from Amgen, Apple, Berkshire Hathaway, Caterpillar, Chevron, CVS Health, Daimler, Discovery, Ford Motor, Gilead Sciences, Honeywell, HP, Honda Motor, IBM, Met Life, PepsiCo, Shire, Toyota, Walmart, and Wells Fargo. We identify these corporate notes in the Bloomberg system by searching for floating rate corporate debt that was issued with two years to maturity during our sample between 2014 and 2018, and for which there was a fixed rate note with the same maturity. This criterion helps us to identify corporate debt that is similar in terms of time to maturity and issuance dates to our set of Treasury FRNs. Table A7 provides descriptive statistics for these pairs of floating/fixed rate securities.

The second class of securities consists of pairs of floating/fixed rate Federal Farm Credit Bank (FFCB) notes. The floating rate cash flows on FFCB notes

are indexed to 13-week Treasury bills. For each floating rate FFCB note we also collect prices of FFCB fixed rate notes that have the same maturity date. Next, analogous to how we swap Treasury notes into FRNs, we first enter into a plain-vanilla Libor interest rate swap, receiving fixed and paying floating. Then we swap the floating Libor leg from interest rate swap into floating cash flows indexed to 13-week Treasury bill rates using the same set of basis swaps that we apply to swap Treasury notes into FRNs. This means that we not only use the same set of swaps, but we also keep all adjustments that we describe in Appendix A.4 fixed. Again, finding no statistically significant premia in the prices of FFCB floating rate notes would suggest that the Treasury bill basis swaps that we use in our main analysis are not driving our FRN stability premia estimates.

The data on FFCB notes consist of 32 pairs of two-year floating and fixed rate notes during the 2014 to 2018 period. Similar to Treasury FRNs, the floating rate notes pay quarterly coupon cash flows based on the 13-week Treasury bill rate during the quarter plus a constant spread expressed in basis points. For each of the 32 floating rate notes we identify a matching fixed rate note that is closest in maturity to the floating rate issue. Table A8 provides descriptive statistics for these pairs of floating/fixed rate FFCB securities.

A.7.2 Collateral Values

As discussed, the Federal Reserve accepts Treasury FRNs as collateral for Discount Window Lending and Payment System Risk purposes, and FRNs receive the same collateral margin treatment as Treasury bills, notes, and bonds. For example, see https://www.frbdiscountwindow.org/articles/2014/07/23/11/18/acceptance-of-us-treasury-floating-rate. FRNs are also specifically designated as accepted collateral for the Treasury Tax and Loan Program and for Depositaries and Financial Agents of the Federal Government (31 CFR parts 202 and 203) and face the same one-percent haircut as Treasury notes and bonds with the same maturity. In particular, see https://www.treasurydirect.gov/instit/statreg/collateral/collateral.htm. Treasury FRNs are also acceptable as collateral at the

Chicago Mercantile Exchange and have the same two-percent haircut requirement as Treasury notes and bonds, see https://www.cmegroup.com/clearing/financial-and-collateral-management/acceptable-collateral-for-treasuries-tips-and-strips.html.

A.7.3 Tax Differences

As discussed in the paper, there is no difference in the tax treatment of FRNs and Treasury notes. The tax treatment of Treasury bills and STRIPS is similar to that of Treasury notes and bonds with the exception that some taxable investors must include an imputed accretion in the principal amount of the Treasury bill or STRIP as interest income (essentially an original issue discount (OID) amortization). We note, however, that studies of the pricing of Treasury securities issued at discounts have not found evidence of inputed accretion tax effects. For example, see Grinblatt and Longstaff (2000) and Jordan, Jorgensen, and Kuipers (2000).

References

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Jordan, B.D., Jorgensen, R.D., Kuipers, D.R. 2000. The relative pricing of U.S. Treasury STRIPS: empirical evidence. Journal of Financial Economics 56, 89-123.

Longstaff, F.A., Liu, J., Mandell, R.E. 2006. The market price of risk in interest rate swaps: the roles of default and liquidity risk. Journal of Business 79, 2337-2360.

Table A1
Data Definitions and Sources.
This table summarizes the datasets used in this study. Frequency shows at what intervals the data are available. Description and Source show the data source and its definition. All data are for the period from January 2014 through March 2018.

	Data	Frequency	Description and Source
1	Treasury Floating Rate Note Prices	Daily	Two-year U.S. Treasury floating rate notes end-of-day closing mid, bid, and ask prices, floating rate spreads, issue and maturity dates from the Bloomberg system and from Thomson Reuters.
2	Treasury Floating Rate Reference Index	Daily	Two-year U.S. Treasury floating rate notes reference index. Treasury FRNs are indexed to the most recent 13-week Treasury bill auction high yield prior to the lockout period, which is the highest accepted discount rate in a Treasury bill auction. The U.S. Treasury publishes this index at https://www.treasurydirect.gov/ instit /annceresult/annceresult/frn.htm
3	Treasury Note Prices	Daily	Two-year U.S. Treasury notes end-of-day mid, bid, and ask prices, yields, coupon rates, issue and maturity dates from the Bloomberg system and from the Thomson Reuters Eikon system.
4	Treasury Bill Prices	Daily	U.S. Treasury bill end-of-day mid, bid, and ask prices, and issue and maturity dates from the Bloomberg system and the U.S. Treasury auction tables. Data consists of Treasury bills with tenors of 4-, 13-, 26-, and 52-weeks to maturity.
5	Treasury Auction Data	Monthly	Two-year U.S. Treasury floating rate notes, two-year Treasury notes and Treasury bill auction results from the website of U.S. Treasury at https://www.treasury direct.gov/instit/annceresult/ press/press.htm. For Treasury floating rate notes, data are the floating rate auction spread, the auction high discount margin, and the floating rate index determination date. For two-year Treasury notes, the auction data are the coupon rate and the auction high yield and for 4-, 13-, 26- and 52-week Treasury bills the auction high yield. In addition, the auction results include prices and accrued interest at auction, auction announcement and auction dates, dated dates, issue dates, and maturity dates, amounts bid by competitive and non-competitive bidders, amounts issued, and bid-to-cover ratios.
6	Treasury STRIPS	Daily	Zero coupon rates of U.S. Treasury STRIPS for six months, one year, and two years to maturity from the Bloomberg system.
7	Discount Function	Daily	Discount function out to two years calculated from GC repo rates and Treasury STRIPS data (see Liu, Longstaff, Mandell (2006)).
8	Treasury Bill Basis Swap Spreads	Daily	Thirteen-week U.S. Treasury bill yield into three-month Libor basis swap spreads. Spreads on U.S. Treasury basis swaps with quarterly cash flows are quoted on the Bloomberg system for tenors of 3, 6, 9, 12, 18, and 24 months.

Table A1 - Continued
Data Definitions and Sources.

	Data	Frequency	Description and Source
9	Libor Interest Rate Swap Spreads	Daily	Three-month Libor into fixed interest rate swap rates. Cash flows on the fixed leg are semiannual, and the floating leg pays three-month Libor each quarter.
10	Thirteen-week Treasury Bill Yields	Daily	Discount yields of the on-the-run 13-week U.S. Treasury bill.
11	Treasury CMT Rate	Daily	One-year constant maturity Treasury rate from Federal Reserve H.15 Selected Interest Rates Release.
12	Institutional Ownership	Quarterly	Institutional ownership of Treasury FRNs and Notes collected from the Bloomberg system via its HDS reports. The Bloomberg system collects the holdings information from regulatory filings including Form 13F, Form N-MFP, Form 10-K, IRS Form 990, Department of Labor Form 5500, NAIC Form Schedule D, and public disclosures from pension funds, hedge funds, money market funds, and ETFs.
13	Money Market Fund Holdings	Monthly	Portfolio holdings of money market funds obtained from Form N-MFP filings with the SEC and downloaded via the SEC's EDGAR (Electronic Data Gathering, Analysis, and Retrieval) database.
14	Interest Rate Forecasts	Monthly	Interest rate forecasts of two-year Treasury yields and of three-month Libor rates from the Bloomberg Professional Survey (BY2 US and EC3MUS). Forecasts are at the monthly frequency for interest rates three months ahead.
15	Swaption Volatility Index	Monthly	Index of basis point volatility of interest rates implied from swaptions. Index data from the Bloomberg system.
16	TED Spread	Monthly	The spread between three-month dollar Libor and three-month Treasury bill rates. Data from the Bloomberg system.
17	Consumer Confidence	Monthly	The Michigan Consumer Sentiment Index (MCSI) of U.S. consumer confidence levels conducted by the University of Michigan.
18	Treasury CDS	Monthly	The two-year sovereign credit default swap spread on U.S. Treasury debt from the Bloomberg system.
19	Money Supply	Monthly	Amount of currency, total demand deposits in depository institutions, and total time deposits. Data from the Federal Reserve, Money Stock and Debt Measures H.6 Release.

Table A1 - Continued
Data Definitions and Sources.

	Data	Frequency	Description and Source
20	Money Market Fund Flows	Monthly	Net cash flows into government and non-government (combined retail and institutional) money market funds. Non-government funds consist of prime, municipal and tax-exempt money market funds. Data from the Investment Company Institute.
21	Money Market Fund Assets	Monthly	Net assets of government and non-government (combined retail and institutional) money market funds. Non-government funds consist of prime, municipal and tax-exempt money market funds. Data from the Investment Company Institute.
22	Corporate Floating Rate Notes	Daily	Two-year U.S. corporate floating rate notes end-of-day closing mid, bid, and ask prices, floating rate spreads, issue and maturity dates from the Bloomberg system. All bonds are issued between January 2014 and March 2018, have two years to maturity at issue, no embedded options, and pay off par at maturity.
23	Federal Farm Credit Bank Notes	Daily	Federal Farm Credit Bank (FFCB) floating rate notes end-of-day closing mid, bid, and ask prices, floating rate spreads, issue and maturity dates from the Bloomberg system. All FFCB bonds are indexed to three-month Treasury bills, are issued between January 2014 and March 2018, and have no embedded options.

Table A2
Summary Statistics for Treasury Bill Basis Swaps.
This table presents summary statistics for Treasury bill basis swaps. Treasury bill basis swaps exchange the floating 13-week Treasury bill market rate plus a spread B for three-month Libor on a quarterly basis over the life of the contract. The spread B is annualized and measured in basis points. The column titled Months to Maturity lists the tenors of the basis swap contracts in months. The columns titled Mean, Median, Min, and Max show the average, median, smallest, and largest spreads B over the sample period. The column titled Std Dev shows the sample standard deviation of B. N denotes the number of observations. The sample period is daily from January 2014 to March 2018.

Months to Maturity	Mean	Std Dev	Min	Median	Max	N
3	29.45	11.57	12.59	23.93	70.81	1,085
6	30.25	10.52	14.73	25.01	63.34	1,085
9	30.48	10.05	15.72	25.53	56.65	1,085
12	31.13	9.74	16.29	26.67	55.92	1,085
15	31.75	9.42	16.68	27.88	55.75	1,085
18	32.36	9.13	16.90	29.08	55.58	1,085
21	33.03	9.15	17.28	29.89	55.42	1,085
24	33.69	9.21	17.66	30.61	55.26	1,085

Table A3
Summary Statistics for Three-Month Libor Interest Rate Swaps.
This table presents summary statistics for three-month Libor interest rate swaps. Interest rate swaps exchange the floating three-month Libor rate set at the beginning of each quarter against a fixed rate F on a quarterly basis over the life of the contract. The spread F is annualized and measured in basis points. The column titled Months to Maturity lists the tenors of the basis swap contracts in months. The columns titled Mean, Median, Min, and Max show the average, median, smallest, and largest spreads F over the sample period. The column titled Std Dev shows the sample standard deviation of F. N denotes the number of observations. The sample period is daily from January 2014 to March 2018.

Months to Maturity	Mean	Std Dev	Min	Median	Max	N
3	73.19	51.48	22.78	63.55	235.32	1,085
6	78.09	53.50	23.05	68.16	235.77	1,085
9	83.19	54.53	23.85	72.01	238.75	1,085
12	88.62	54.74	25.30	75.02	243.35	1,085
15	94.31	54.14	28.29	78.54	249.57	1,085
18	100.37	53.19	31.95	82.46	255.13	1,085
21	106.55	51.87	36.63	87.41	259.87	1,085
24	112.78	50.35	42.50	93.69	263.91	1,085

Table A4
Cash Flows from Replicating a FRN Using a Treasury Note.
This table illustrates the cash flows from the replication strategy for a two-year FRN. The replication strategy consists of taking a long position in a two-year Treasury note, swapping its fixed coupon cash flows into floating using interest rate and basis swaps, and taking a small position in Treasury STRIPS to match the FRN spread. C denotes the semiannual coupon of the Treasury note. F denotes the semiannual fixed coupon payment for the interest rate swap. B denotes the quarterly fixed basis swap spread (actual/360). S denotes the quarterly spread for the FRN (actual/360). L_t denotes the quarterly Libor cash flow based on the three-month Libor rate set at the beginning of the quarter in which the cash flow is paid (actual/360). X_t denotes the floating cash flow computed as the average of the 13-week Treasury bill rates averaged over the quarter in which the cash flow is paid (actual/360). P_N denotes the price of the two-year Treasury note. P_{FRN} denotes the price of the Treasury FRN. ϵ denotes the sum of the prices of the STRIPS in the replicating portfolio. The columns titled Synthetic FRN illustrate the cash flows from the replication strategy. The column titled Treasury FRN illustrates the cash flows from the two-year FRN being replicated.

	Synthetic FRN					Treasury FRN
Timing of Cash Flow	T-Note Cash Flow	Swap Cash Flow	Basis Swap Cash Flow	STRIPS Cash Flow	Total Cash Flow	Total Cash Flow
0.00	$-P_N$	–	–	$-\epsilon$	$-(P_N+\epsilon)$	$-P_{FRN}$
0.25	–	L_t	$(X_t+B)-L_t$	$S-B$	$S+X_t$	$S+X_t$
0.50	C	$-F+L_t$	$(X_t+B)-L_t$	$S-C-B+F$	$S+X_t$	$S+X_t$
0.75	–	L_t	$(X_t+B)-L_t$	$S-B$	$S+X_t$	$S+X_t$
1.00	C	$-F+L_t$	$(X_t+B)-L_t$	$S-C-B+F$	$S+X_t$	$S+X_t$
1.25	–	L_t	$(X_t+B)-L_t$	$S-B$	$S+X_t$	$S+X_t$
1.50	C	$-F+L_t$	$(X_t+B)-L_t$	$S-C-B+F$	$S+X_t$	$S+X_t$
1.75	–	L_t	$(X_t+B)-L_t$	$S-B$	$S+X_t$	$S+X_t$
2.00	$100+C$	$-F+L_t$	$(X_t+B)-L_t$	$S-C-B+F$	$100+S+X_t$	$100+S+X_t$

Table A5
Cash Flows from Replicating a FRN Using Treasury Bills.
This table illustrates the cash flows from the replication strategy for a FRN with one year to maturity. The replication strategy consists of positions in 3-, 6-, 9-, and 12-month Treasury bills combined with interest rate and basis swaps. F denotes the semiannual fixed coupon payment for the interest rate swap. B denotes the quarterly fixed basis swap spread (actual/360). S denotes the quarterly spread for the FRN (actual/360). L_t denotes the quarterly Libor cash flow based on the three-month Libor rate set at the beginning of the quarter in which the cash flow is paid (actual/360). X_t denotes the quarterly cash flow computed as the average of the 13-week Treasury bill rates averaged over the quarter in which the cash flow is paid (actual/360). $P(T)$ denotes the price of a Treasury bill with maturity T. P_{FRN} denotes the price of the Treasury FRN. The columns titled Synthetic FRN illustrate the cash flows from the replication strategy. The column titled Treasury FRN illustrates the cash flows from the two-year FRN being replicated.

	Synthetic FRN				Treasury FRN
Timing of Cash Flow	T-Bill Portfolio	Swap Cash Flow	Basis Swap Cash Flow	Total Cash Flow	Total Cash Flow
0.00	$-(S-B)P(0.25)$ $-(S-B+F)P(0.50)$ $-(S-B)P(0.75)$ $-(100+S-B+F)P(1.00)$	–	–	$-(S-B)P(0.25)$ $-(S-B+F)P(0.50)$ $-(S-B)P(0.75)$ $-(S-B+F+100)P(1.00)$	$-P_{FRN}$
0.25	$S-B$	L_t	$(X_t+B)-L_t$	$S+X_t$	$S+X_t$
0.50	$S-B+F$	$-F+L_t$	$(X_t+B)-L_t$	$S+X_t$	$S+X_t$
0.75	$S-B$	L_t	$(X_t+B)-L_t$	$S+X_t$	$S+X_t$
1.00	$100+S-B+F$	$-F+L_t$	$(X_t+B)-L_t$	$100+S+X_t$	$100+S+X_t$

Table A6
Numerical Example of the Cash Flows from Replicating an FRN Using Treasury Bills.
This table provides a numerical illustration of the cash flows from the replication strategy for a FRN with one year to maturity. The replication strategy consists of positions in 3-, 6-, 9-, and 12-month Treasury bills combined with interest rate and basis swaps. This example is based on market prices as of January 31, 2017. The Treasury FRN being replicated was issued on January 31, 2017 and has a maturity date of January 31, 2019 and a fixed spread of 14.00 basis points. The 3-, 6-, 9-, and 12-month Treasury bills have market prices of 99.6455, 99.1868, 98.7402, and 98.1374, respectively. The fixed market rate on a Libor interest rate swap is 2.0960 percent paid semiannually, in exchange for three-month Libor paid quarterly (actual/360) L_t, where Libor is set at the beginning of the quarter in which it is paid. The Treasury bill basis swap pays a quarterly stream of cash flows equal to the Treasury bill rate averaged over the quarter in which it is paid (actual/360) X_t, plus the basis swap spread of 30.55 basis points (actual/360), in exchange for quarterly three-month Libor cash flows (actual/360) L_t. The cost of taking a position in Treasury bills and swaps to match exactly the cash flows on the FRN is 100.0395. The market price of the FRN being replicated is 100.1914. The columns titled Synthetic FRN illustrate the cash flows from the replication strategy. The column titled Treasury FRN illustrates the cash flows from the FRN being replicated.

	Synthetic FRN				Treasury FRN
Timing of Cash Flow	T-Bill Portfolio	Swap Cash Flow	Basis Swap Cash Flow	Total Cash Flow	Total Cash Flow
0.00	−0.0408 0.9976 −0.0417 99.1244	–	–	−100.0395	−100.1914
0.25	−0.0409	L_t	$(X_t + 0.0750) - L_t$	$0.0341 + X_t$	$0.0341 + X_t$
0.50	1.0057	$-1.0480 + L_t$	$(X_t + 0.0776) - L_t$	$0.0353 + X_t$	$0.0353 + X_t$
0.75	−0.0423	L_t	$(X_t + 0.0776) - L_t$	$0.0353 + X_t$	$0.0353 + X_t$
1.00	101.0057	$-1.0480 + L_t$	$(X_t + 0.0776) - L_t$	$100.0353 + X_t$	$100.0353 + X_t$

Table A7
Descriptive Statistics for U.S. Corporate Bond Floating Rate/Fixed Rate Note Pairs.
This table presents descriptive statistics for the two-year U.S. corporate floating rate bonds and and matched-maturity fixed rate notes of the same parent company in the sample. The spread of the floating rate bond is measured in basis points. The fixed rate bond coupon rate is expressed as a percentage. Amount denotes the total par amount issued by the parent company and is measured in millions of dollars. NC denotes the number of coupon cash flows per year. The sample period is daily from June 2015 to March 2018.

		Two-Year Corporate Floating Rate Bond				Matched-Maturity Corporate Fixed Rate Bond			
Pair	Parent Company	Maturity	Spread	NC	Issued	Maturity	Coupon	NC	Issued
1	CVS Health	3–9–2020	63	4	1000	3–9–2020	3.125	2	2000
2	Caterpillar	3–22–2019	28	4	250	3–22–2019	1.900	2	650
3	Caterpillar	11–29–2019	13	4	300	11–29–2019	2.000	2	600
4	Wells Fargo	11–28–2018	50	4	700	11–28–2018	1.800	2	800
5	Wells Fargo	1–15–2020	23	4	1000	1–15–2020	2.400	2	1750
6	Discovery	9–20–2019	71	4	400	9–20–2019	2.200	2	500
7	Honda Motor	11–19–2018	28	4	750	11–19–2018	1.500	2	450
8	Apple	2–8–2019	8	4	500	2–8–2019	1.550	2	500
9	Gilead Sciences	9–20–2019	25	4	500	9–20–2019	1.850	2	1000
10	Amgen	5–10–2019	32	4	300	5–10–2019	1.900	2	700
11	Honeywell	10–30–2019	4	4	450	10–30–2019	1.800	2	750
12	PepsiCo	5–2–2019	4	4	350	5–2–2019	1.550	2	750
13	Toyota Motor	1–10–2020	10	4	400	1–10–2020	2.200	2	750
14	IBM	9–6–2019	15	4	600	9–6–2019	1.625	2	800
15	Toyota Motor	1–9–2019	26	4	400	1–9–2019	1.700	2	850
16	Chevron	2–28–2019	9	4	450	2–28–2019	1.686	2	550
17	Walmart	10–9–2019	-3	4	300	10–9–2019	1.750	2	1200
18	Shire	6–22–2018	78	4	375	6–22–2018	2.000	2	374
19	Honda Motor	11–13–2019	15	4	350	11–13–2019	2.000	2	600
20	Metropolitan Life	9–19–2019	22	4	950	9–19–2019	1.750	2	500
21	Metropolitan Life	12–19–2018	43	4	500	12–19–2018	1.750	2	500
22	Metropolitan Life	9–14–2018	34	4	350	9–14–2018	1.350	2	550
23	Metropolitan Life	9–14–2018	34	4	350	9–14–2018	1.350	2	550
24	Metropolitan Life	9–19–2019	22	4	950	9–19–2019	1.750	2	500
25	Wells Fargo	1–22–2018	74	4	2000	1–22–2018	1.650	2	2000

Table A7 - Continued
Descriptive Statistics for U.S. Corporate Bond Floating Rate/Fixed Rate Note Pairs.
This table presents descriptive statistics for the two-year U.S. corporate floating rate bonds and and matched-maturity fixed rate notes of the same parent company in the sample. The spread of the floating rate bond is measured in basis points. The fixed rate bond coupon rate is expressed as a percentage. Amount denotes the total par amount issued by the parent company and is measured in millions of dollars. NC denotes the number of coupon cash flows per year. The sample period is daily from June 2015 to March 2018.

		Two-Year Corporate Floating Rate Bond				Matched-Maturity Corporate Fixed Rate Bond			
Pair	Parent Company	Maturity	Spread	NC	Issued	Maturity	Coupon	NC	Issued
26	Metropolitan	12–19–2018	43	4	500	12–19–2018	1.750	2	500
27	Caterpillar	2–23–2018	70	4	425	2–23–2018	1.500	2	775
28	Berkshire Hathaway	3–7–2018	55	4	1000	3–7–2018	1.450	2	750
29	Daimler AG	8–3–2017	71	4	550	8–3–2017	1.600	2	450
30	Apple	5–12–2017	5	4	250	5–12–2017	0.900	2	750
31	PepsiCo	7–17–2017	25	4	600	7–17–2017	1.125	2	650
32	Ford Motor	3–27–2017	63	4	500	3–27–2017	1.461	2	650
33	Chevron	11–9–2017	36	4	500	11–9–2017	1.344	2	1000
34	PepsiCo	10–13–2017	35	4	700	10–13–2017	1.000	2	450
35	Hewlett Packard	10–5–2017	174	4	350	10–5–2017	2.450	2	2250
36	Hewlett Packard	10–5–2017	174	4	350	10–5–2017	2.450	2	2250
37	Toyota Motor	4–6–2018	38	4	350	4–6–2018	1.200	2	900
38	Daimler AG	8–3–2017	71	4	550	8–3–2017	1.600	2	450

Table A8
Descriptive Statistics for Federal Farm Credit Bank Floating Rate/Fixed Rate Note Pairs.
This table presents descriptive statistics for the Federal Farm Credit Bank floating rate bonds and matched-maturity fixed rate notes. The floating rate bonds pay quarterly coupon cash flows based on the 13-week Treasury bill rate during the quarter plus a constant spread expressed in basis points. The coupon rate of the matched-maturity semi-annual fixed rate bonds are expressed as a percentage. Maturity Date and Issue Date denote the maturity and issue dates of the bonds, respectively. Amount denotes the total par amount issued and is measured in millions of dollars. NC denotes the number of coupon cash flows per year. The sample period is daily from January 2014 to March 2018.

Pair	Maturity	Issue Date	Spread	NC	Amount	Maturity Date	Issue Date	Coupon	NC	Amount
1	8–1–2018	8–1–2016	35	4	100	8–1–2018	8–1–2008	5.05	2	183
2	11–13–2018	1–13–2017	28	4	200	11–14–2018	11–14–2011	1.78	2	63
3	11–14–2018	2–14–2017	20	4	100	11–14–2018	11–14–2011	1.78	2	63
4	12–3–2018	2–28–2017	19	4	100	12–3–2018	12–3–2015	1.3	2	105
5	12–5–2018	12–5–2016	30	4	200	12–5–2018	12–5–2016	1.1	2	394
6	12–5–2018	6–5–2017	5	4	200	12–5–2018	12–5–2016	1.1	2	394
7	1–25–2019	4–25–2017	10	4	100	1–24–2019	4–24–2017	1.22	2	100
8	2–19–2019	7–19–2017	9	4	100	2–15–2019	2–15–2018	1.95	2	60
9	3–12–2019	6–12–2017	6.5	4	100	3–15–2019	3–15–2007	5.05	2	15
10	3–13–2019	3–13–2017	15	4	100	3–15–2019	3–15–2007	5.05	2	15
11	3–22–2019	3–22–2017	16	4	100	3–22–2019	3–22–2018	2.13	2	100
12	3–25–2019	5–25–2017	8	4	100	3–25–2019	11–25–2005	5.125	2	10
13	4–12–2019	4–12–2017	15	4	150	4–17–2019	4–17–2017	1.32	2	220
14	5–8–2019	5–8–2017	12	4	100	5–8–2019	2–8–2018	2	2	100
15	6–19–2019	6–19–2017	9	4	100	6–19–2019	9–19–2017	1.375	2	93
16	6–27–2019	6–27–2017	10	4	100	6–27–2019	3–27–2018	2.25	2	45
17	7–3–2019	7–3–2017	10	4	100	7–2–2019	7–2–2012	1.48	2	17
18	7–5–2019	10–5–2017	8.5	4	125	7–2–2019	7–2–2012	1.48	2	17
19	7–26–2019	7–26–2017	9	4	150	7–24–2019	7–24–2017	1.4	2	226
20	8–8–2019	8–8–2017	8.5	4	100	8–5–2019	8–5–2015	1.5	2	75
21	9–20–2019	9–20–2017	9.5	4	250	9–18–2019	9–18–2008	4.5	2	30
22	10–18–2019	10–18–2017	7.5	4	125	10–17–2019	10–17–2016	1.05	2	95
23	10–18–2019	12–18–2017	5	4	200	10–17–2019	10–17–2016	1.05	2	95
24	11–1–2019	11–1–2017	7.5	4	125	11–1–2019	3–22–2017	1.64	2	30
25	11–4–2019	1–4–2018	5	4	100	11–5–2019	1–5–2015	1.8	2	25
26	11–20–2019	11–20–2017	6.5	4	200	11–19–2019	11–19–2015	1.6	2	40
27	11–29–2019	11–29–2017	6.5	4	100	11–26–2019	11–26–2012	1.18	2	23
28	12–26–2019	12–26–2017	7.5	4	100	12–26–2019	5–26–2017	1.4	2	90
29	2–12–2020	2–12–2018	4	4	100	2–11–2020	2–11–2013	1.45	2	15
30	2–19–2020	3–19–2018	5	4	100	2–19–2020	3–19–2018	2.3	2	47
31	3–26–2020	3–26–2018	8.5	4	200	3–27–2020	3–27–2018	2.375	2	470
32	11–12–2020	12–12–2017	13	4	100	11–12–2020	11–12–2013	2.375	2	5