NBER WORKING PAPER SERIES

FLOATING RATE MONEY? THE STABILITY PREMIUM IN TREASURY FLOATING RATE NOTES

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Working Paper 25216
http://www.nber.org/papers/w25216

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
November 2018

We are grateful for the comments and insights of John Cochrane, Douglas Diamond, Mark Grinblatt, Burton Hollifield, Batchimeg Sambalaibat, Yao Zeng, and seminar participants at the LAEF OTC Markets and Securities Workshop at UC Santa Barbara, and at UCLA. All errors are our responsibility. We received no outside sources of research support for this work. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

At least one co-author has disclosed a financial relationship of potential relevance for this research. Further information is available online at http://www.nber.org/papers/w25216.ack

Floating Rate Money? The Stability Premium in Treasury Floating Rate Notes
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NBER Working Paper No. 25216
November 2018
JEL No. G12,G18

ABSTRACT

We identify a significant premium in the prices of Treasury floating rate notes (FRNs) relative to both Treasury bills and notes. This premium is directly related to the near-constant nature of FRN prices and differs from the liquidity and on-the-run premia in Treasury security prices previously documented in the literature. We find that the premium is related to measures reflecting investor demand for safe assets such as market volatility and flows into money market funds. Ironically, some of the variation in FRN prices may actually be due to changes in the premium for their price stability.

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1. INTRODUCTION

A number of important recent empirical studies have shown that markets place a significant premium on the liquidity and safety of near-money assets. Foremost among these are Treasury securities because of the unique role they play as a store of value during flights-to-security in financial markets. For example, Treasury bonds often trade at a large premium relative to other bonds that are likewise guaranteed by the full faith and credit of the United States (Longstaff (2004) and Lewis, Longstaff, and Petrasek (2017)).

The empirical evidence also indicates that the premium is larger for some Treasury securities than for others, suggesting that some Treasuries may be viewed as "nearer-to-money" than others. For example, liquid on-the-run Treasury bills and bonds trade at a premium to older off-the-run Treasury securities with similar maturities (Amihud and Mendelson (1991), Kamara (1994), and Krishnamurthy (2002)).[1]

This paper studies the market prices of what may be the nearest-to-money of all near-money assets—Treasury floating rate notes (FRNs). By nature of their security design, FRN prices fluctuate far less than those of other Treasury securities. Furthermore, FRNs represent informationally-insensitive debt in the sense of Dang, Gorton, and Holmström (2015) since their market values are virtually unaffected by either private or public information. Thus, FRNs are among the most-stable collateral or store-of-value options available in financial markets. Since their introduction in 2014, FRNs have quickly become one of the most popular types of Treasury debt with more than $720 billion issued to date. Treasury FRN auctions have generally experienced bid-to-cover ratios substantially higher than those of fixed rate Treasury debt with the same maturity. Demand for FRNs has been particularly strong among broker-dealers and foreign institutions such as central banks who tend to purchase a far larger share of the total issue amount in FRN auctions than they do in other Treasury auctions. If investors view FRNs as nearer-to-money, then their prices may incorporate an additional premium relative to other Treasury debt.

[1]Other key examples of this literature include Duffee (1996), Krishnamurthy and Vissing-Jorgensen (2012), Fleckenstein, Longstaff, and Lustig (2014), Nagel (2016), and Musto, Nini, and Schwarz (2018).

To address this issue, we study the relative valuation of FRNs and other Treasury debt. In doing this, we use a no-arbitrage approach in which the premium is identified as the difference between the FRN price and the value of a replicating portfolio of Treasury bills or notes. A key advantage of this approach is that by comparing FRNs to a replicating portfolio with identical cash flows, duration, and maturity date, we control for any potential credit or refinancing-rollover risk associated with Treasury financing.[2]

We find that the market incorporates a substantial premium into the prices of FRNs relative to the price of a replicating portfolio of Treasury bills or notes. This holds true across the entire maturity spectrum as we compare FRN prices to replicating portfolios using fixed rate securities ranging from three-month on-the-run Treasury bills to the most-recently-auctioned two-year Treasury notes. On average, the premium is 5.92 basis points relative to Treasury bills, and 9.82 basis points relative to Treasury notes. These premia, however, vary significantly through time and can exceed 30 basis points (or, alternatively, more than 40 cents per $100 par amount). Furthermore, these premia are economically large, almost uniformly positive, and are orders of magnitude larger than the bid-ask spreads for these actively-traded and highly-liquid Treasury bills, notes, and FRNs. We also confirm that these premia differ from the liquidity, safety, and on-the-run premia in Treasury securities previously documented in the literature.

Our results also show that the size of the premium is directly related to the difference in the price volatility of FRNs and matched-maturity Treasury bills and notes. In particular, we find that the cross-section of premia is significantly and positively related to the difference in price volatilities. These intuitive results provide strong support for the view that economic agents value the price stability of FRNs relative to other near-money assets. Furthermore, these results suggest that the difference between FRN prices and their no-arbitrage replication values can be interpreted as an additional premium for their relative price stability. Accordingly, we denote these premia as "stability premia".

We also examine whether the time-series variation in stability premia is related to measures reflecting investor demand for safe assets. The results indicate that changes in the average premia are strongly related to variables that proxy for economic uncertainty and systemic risk such as market volatility and dealer funding liquidity measures. Furthermore, the premia measured relative to Treasury notes are directly related to flows into the safest types of money market mutual funds. Consistent with Nagel (2016), the average premia are significantly related to the opportunity cost of holding money as measured by short-term in-

[2]Given this no-arbitrage approach, the premia we identify can also be interpreted as violations of the law of one price.

terest rates. Finally, we show that the results are not due to the possibility of mispricing in the swaps used to convert fixed cash flows into floating cash flows in our approach.

These results have a number of important implications. First, they suggest that economic agents place a high value on the store-of-value function of money. In particular, the results indicate that the market incorporates a large additional premium into the prices of the near-money assets whose prices fluctuate the least (the nearest-to-money assets). Second, our findings have implications for the management of sovereign debt. Specifically, the results suggest that the U.S. Treasury could potentially reduce its debt financing costs by issuing floating rate debt with near-constant market values that are largely unaffected by either public or private information. A simple calculation suggests that the total savings to the Treasury from the more than $720 billion of two-year FRNs issued to date could approach a billion dollars. In theory, the potential savings from refunding all fixed rate Treasury debt with floating rate debt could be orders of magnitude larger.

2. RELATED LITERATURE

There is a rapidly growing theoretical literature focusing on the special role that safe assets such as Treasury securities play in the economy. Important examples include Caballero, Farhi, and Gourinchas (2008), Caballero and Krishnamurthy (2009), Gorton and Ordoñez (2013), He, Krishnamurthy, and Milbradt (2016a, 2016b), Cochrane (2015), and Duffie (2015). Guiband, Nosbusch, and Vayanos (2013) present a clientele model of the optimal maturity structure of government debt. Greenwood, Hanson, and Stein (2010, 2015) study optimal government debt maturity in a model where short-term riskless debt provides monetary services to agents. Vayanos and Weill (2008) use a search-based model to study the on-the-run liquidity premium in Treasury securities. Dang, Gorton, and Holmström (2015) consider the role that the informational sensitivity of a security plays in its valuation. Our empirical results about the existence of an additional premium related to the price stability of FRNs provide support for the implications of many of these theoretical models.

There is also an extensive empirical literature documenting that the prices of near-money assets such as those of Treasury securities incorporate liquidity and safety premia. Key examples include Amihud and Mendelson (1991) and Kamara (1994) who show that liquid Treasury bills trade at a premium relative to older less-liquid Treasury notes and bonds with similar maturities. Duffee (1996) documents idiosyncratic variation in the prices of Treasury bills. Longstaff (2004) and Lewis, Longstaff, and Petrasek (2017) show that Treasury securities trade at a premium relative to agency or corporate bonds that are likewise guaranteed by the full faith and credit of the United States. Krishnamurthy (2002) finds that on-the-run Treasury bonds are priced at a premium relative to less-liquid off-the-run Treasury bonds. Greenwood and Vayanos (2014) find that Treasury supply affects the expected returns of long-term Treasury securities. Krishnamurthy and Vissing-Jorgensen (2012) show that Treasury bond prices incorporate significant safety and liquidity premia. Nagel (2016) compares general collateral repo rates to Treasury bill yields and finds that Treasury bills incorporate a significant liquidity premium. Furthermore, Nagel (2016) finds that this liquidity premium is directly related to the opportunity cost of money as reflected by short-term interest rates, and that controlling for this opportunity cost largely subsumes Treasury supply-related factors. Our paper extends this literature by showing that in addition to the liquidity and safety premia previously documented in the literature, nearer-to-money assets such as FRNs may also incorporate an additional premium for their price stability or capital-preservation role in financial markets.

An important recent paper by Hartley and Jermann (2018) also studies the valuation of FRNs. They argue that two-year FRNs are priced at a discount relative to the current and forecasted values of three-month Treasury bills. An insightful contribution of Hartley and Jermann (2018), however, is the recognition that some portion of the discount they estimate may be related to the rollover risk induced by the maturity difference between the FRNs and Treasury bills used in their analysis (also see He and Xiong (2012)). In light of this, our paper conducts an apples-to-apples comparison of the pricing of FRNs to that of matched-maturity replicating portfolios of Treasury bills and notes. An important advantage of this no-arbitrage approach is that it allows for a clean identification of the premium while holding fixed the credit or rollover risk of Treasury financing.[3]

3. TREASURY FLOATING RATE NOTES

Like Treasury bills, notes, and bonds, FRNs are direct obligations of the Treasury and are backed by the full faith and credit of the U.S. government. The key difference is that the coupon cash flows of FRNs are indexed to the most-recent

[3]Because of the potential credit or refinancing risk of Treasury securities, FRNs are not equivalent to rolling over a series of three-month Treasury bills. See the discussion in Duffie (2015), Cochrane (2015), and Bhanot and Guo (2017).

13-week Treasury bill auction high rate plus a constant spread.[4] Thus, the coupon accrual rate on these securities varies through time with the weekly auction cycle for 13-week Treasury bills. FRNs pay quarterly coupon cash flows on the last calendar day of the corresponding month. The dollar amount of the coupon payment is the cumulative arithmetic total of the daily interest accrual over the quarter. The daily interest accrual rate is floored at zero percent. At maturity, FRNs are redeemed at their par value.

FRNs are currently issued with a maturity of two years. The first FRN was issued on January 31, 2014. Since then, the Treasury has auctioned FRNs every three months in January, April, July, and October, and reopened the FRNs in the two subsequent months after the original issue. As of March 31, 2018, the total par amount of all FRNs issued was $720.969 billion.

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 U.S. Treasury first accepts in full all noncompetitive tenders up to $5 million per submitter. 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. The Online Appendix to the paper provides additional details about the Treasury FRN market and the auction process.[5]

4. TREASURY FLOATING RATE NOTE PRICES

By nature of their contract design, Treasury FRN prices are very stable and remain close to their par values. To illustrate this, Table 1 presents summary statistics for the daily market prices of the individual FRNs issued during the January 2014 to March 2018 sample period. The sources and description of the data (and for all other data used in the study) are given in the Online Appendix.

[4]The spread on a FRN is set at the highest accepted discount margin at the initial auction of the note. For reopening auctions, the spread remains equal to the spread set at the initial auction. See https://www.treasurydirect.gov/instit/marketables/frn/frn.htm.

[5]The Treasury's auction rules are available at https://www.treasurydirect.gov/instit/statreg/auctreg/auctreg.htm.

As shown, the average prices for the individual FRNs are all close to their par value of $100. The average prices for the FRNs range from 99.980 to 100.202. The average price taken over all FRNs is 100.060. Furthermore, the FRN prices display relatively little variation over time. The volatility of the market price over the entire life of an FRN issue is typically only about two to six cents per $100 par amount. Thus, the value at risk (VaR) associated with a long-term investment in an FRN is very modest.

In addition, Treasury FRNs are far less sensitive to changes in both current and expected interest rates than are other Treasury securities with similar maturities but fixed coupon rates. This is shown in Table 2 which reports the volatility of daily price changes for FRNs and for matched-maturity Treasury bills and two-year Treasury notes. For Treasury bills, we include only observations for which the maturity of the FRN is 12 months or less (beginning one year after the initial issuance of the two-year FRN), and then identify the matched Treasury bill as the one with the closest maturity date to the FRN. For two-year Treasury notes, we use the note with the same maturity date as the FRN. The results reported in Table 2 are stratified by the number of months to maturity for the FRNs.

Table 2 shows that the volatility of daily price changes for FRNs is substantially lower than those of the matched-maturity Treasury bills and notes. This result holds uniformly across all maturity categories. As an example, for maturities of between three and four months, the volatility of daily price changes is 0.189, 0.381, and 0.468 cents per $100 par amount for FRNs, Treasury bills, and Treasury notes, respectively. Thus, FRN prices vary far less than Treasury bill and note prices even for maturities as short as three months. The differences in price volatilities are even more striking for longer maturities.

The highly stable nature of FRN prices makes a strong case for why market participants may view them as attractive capital-preservation vehicles during turbulent periods in financial markets.[6] Furthermore, the limited mark-to-market variation in the prices of FRNs also implies that these securities could have important advantages when serving as collateral in secured lending arrangements between financial institutions such as tri-party or GCF repo contracts. Demand for FRNs has been particularly strong among broker-dealers and foreign investors

[6]For example, even traditional money market mutual funds had difficulties in preserving value during the 2008 financial crisis. The Reserve Primary Fund "broke the buck" when its net asset value fell to 97 cents per share on September 16, 2008. Similarly, the Community Bankers U.S. Government Money Market Fund was liquidated at 94 cents per share in 1994 after experiencing large losses in derivatives.

who tend to purchase a much higher proportion of the total issue at FRN auctions than they do at other note auctions.[7]

5. IDENTIFYING THE STABILITY PREMIUM

In comparing the values of FRNs with those of other Treasury securities, it is important to ensure that differences in the risk characteristics of the securities do not contaminate the results. For example, we cannot simply compare the yields of two-year FRNs with those of two-year Treasury notes since the two securities have very different durations or interest rate sensitivities. Similarly, we cannot directly compare the yields on two-year FRNs with those for three-month Treasury bills since the two securities differ fundamentally in their exposure to Treasury credit or rollover risk.

To address this issue, we use a simple no-arbitrage replication approach to identify the premium in FRN prices. The key to this approach is that there is an active over-the-counter swap market in which participants can exchange a stream of floating payments for a stream of fixed rate payments. Thus, the floating cash flows from a FRN can be readily swapped out, thereby effectively transforming the FRN into a synthetic fixed rate bond. The stability premium is then measured directly by comparing the price of the swapped FRN with that of a Treasury bond or portfolio of Treasury bills that exactly replicates the cash flows of the swapped FRN. An important advantage of this no-arbitrage approach in which we compare two portfolios with identical cash flows is that the underlying risk characteristics of the two alternatives are also the same. In the absence of arbitrage, two portfolios with identical cash flows should have the same value. Thus, the estimated stability premium actually represents an arbitrage or violation of the law of one price, and is not simply an equilibrium premium compensating investors for differences in risk characteristics. In this section, we first discuss how FRNs can be swapped into fixed rate debt. We then describe how the replication approach is used to identify the premium.

5.1 Swapping FRNs into Fixed

There are large and actively-traded interest rate swap markets in which financial

[7] For example, broker-dealers purchased an average of 53.07 percent of the issue at FRN auctions during the sample period, but only 34.39 percent of the issue at Treasury note auctions during the same time period. See https://www.treasury.gov/resource-center/data-chart-center/Pages/investor_class_auction.aspx.

institutions can exchange a stream of floating cash flows for a stream of fixed cash flows, and vice versa. In a standard swap, the floating leg of a swap is tied to either the three-month Libor rate or the overnight index swap (OIS) rate. However, there is also an active basis swap market that allows institutions to exchange a variety of other floating indexes such as the 13-week Treasury bill index for fixed cash flows.

To convey the intuition, it is useful to illustrate how FRNs can be swapped into fixed with a simple example. Consider an investor who purchases a FRN with three months to maturity. In three months, the investor will receive a cash flow equal to the quarterly floating coupon payment X_t plus the par amount \$100. To swap out the floating cash flow X_t, the investor simply needs to enter into a zero-cost three-month basis swap in which the investor pays the floating coupon X_t and receives a market-determined fixed coupon of F. By entering into this swap, the total cash flow the investor receives in three months is now $F + 100$. Since this total cash flow is fixed, the net effect of the transaction has been to transform the FRN into synthetic fixed rate debt. Furthermore, the total fixed cash flow of $F + 100$ from the swapped FRN is identical to the cash flow from a portfolio of three-month Treasury bills with a total par amount of $F + 100$.

This simple example shows how the basis swap market can be used to swap short-term FRNs into synthetic fixed rate debt which can then be replicated with portfolios of matched-maturity Treasury bills.[8] The Online Appendix provides full details and illustrates how this approach can be easily extended to swap longer-term FRNs into synthetic fixed rate coupon debt, and then replicated using matched-maturity Treasury bills and notes.

5.2 Estimating the Stability Premium

Once the FRN has been swapped into fixed, the premium is readily identified by comparing the price of the resulting synthetic fixed rate debt to that of fixed rate Treasury securities with cash flows that are identical to those of the swapped FRN. In doing this, we estimate the premium relative to both a replicating portfolio of Treasury bills and to matched-maturity Treasury notes.

To estimate the premium relative to Treasury bills, we focus specifically on FRNs with maturities of less than or equal to one year. Following the same

[8]Alternatively, the reverse approach could be used to swap fixed rate Treasury securities into synthetic floating rate debt. We note, of course, that the premia estimates resulting from using this reverse approach are identical to those we obtain.

approach as in the example above, we swap the FRN into fixed. We then identify the Treasury bills with maturities closest to the coupon payment dates for the swapped FRNs. As an example, a swapped FRN with a maturity of one year has two semiannual fixed cash flows—one in 6 months and the other at maturity in 12 months. These cash flows can be replicated using a portfolio of the on-the-run 26-week and 52-week Treasury bills with par amounts equal to the cash flows to be received in 6 months and 12 months, respectively. The premium is then estimated as the difference between the price of the swapped FRN and the price of the replicating portfolio of Treasury bills. In replicating the cash flows of the swapped FRN, we always use the on-the-run or most-recently-auctioned Treasury bill with maturity date closest to that of the FRN.

To estimate the premium relative to Treasury notes, we first identify Treasury notes with maturity dates that match those of the FRNs. Fortunately, the task of finding a matched Treasury note for comparison is straightforward because the Treasury auctions two-year fixed coupon Treasury notes on virtually the same cycle as it auctions two-year FRNs. Thus, for each of the FRNs in the sample, there is a matching two-year fixed coupon Treasury note with an identical maturity date. Furthermore, the auction date of this matched Treasury note is within a day or two of the auction date of the corresponding FRN. Once the matched-maturity two-year Treasury note is determined, the premium is easily identified by comparing the price of the swapped FRN with the price of the corresponding Treasury note.

It is important to reemphasize that the stability premia we identify actually represent violations of the law of one price. This is because the premium is computed as the difference between the price of the swapped FRN and the price of a replicating portfolio with identical cash flows to the swapped FRN. This means that the durations of the swapped FRN and the replicating portfolio are exactly the same. Thus, the stability premia are not merely equilibrium risk premia compensating investors for the differences in duration or interest-rate sensitivity between floating rate and fixed rate Treasury securities. Similarly, since the FRN and the replicating portfolio have identical maturities, potential Treasury credit or rollover risk is held fixed in the analysis. Thus, the estimated stability premia do not include equilibrium credit or rollover risk premia.[9]

[9]In contrast, approaches that compare two-year FRN yields directly to three-month Treasury bill rates have the drawback of confounding near-money premia with credit premia. For a discussion of the implications of rollover risk, see Hartley and Jermann (2018).

6. THE ESTIMATED PREMIA

In this section, we use the no-arbitrage approach described above to solve for the premia in FRNs relative to replicating portfolios of either Treasury bills or Treasury notes. We will generally express the premium in basis points by first swapping the FRNs into fixed, and then taking the difference between the yield on a replicating portfolio of Treasury bills or notes and the yield on the swapped FRN. Occasionally, however, it will be useful to express the premia in terms of prices as cents per $100 par amount—we denote premia expressed this way as price premia.

Table 3 reports summary statistics for the estimated premia by individual FRN issue. The first part of the table reports the results from the comparisons of FRNs to the replicating portfolio of Treasury bills.[10] The second part of the table reports the results from the comparisons of FRNs to the replicating portfolio using two-year Treasury notes. Both sets of results are based on observations for which the maturity of the FRN is greater than or equal to three months. Figure 1 plots the time series of the estimated price premia.

Focusing first on the valuation of FRNs compared to Treasury bills, Table 3 shows that FRN prices incorporate a substantial premium relative to the prices of Treasury bills. The average premia are all positive (with the exception of the first FRN) and highly statistically significant. The average premium taken over all FRNs is 5.92 basis points. The averages for some of the FRNs, however, are in excess of 15 basis points. These averages are an order of magnitude larger than the typical bid-ask spread for FRNs. The table also shows that more than 76 percent of the estimated premia are positive. For some of the more-recent FRN issues, however, 100 percent of the estimated premia are positive.

Turning next to the valuation of FRNs relative to the matched Treasury notes, Table 3 shows that the FRNs are uniformly priced at a large premium to their Treasury note counterparts. The average premium is positive and significant for all 17 of the FRNs with average values typically in excess of 10 basis points. The average premium taken over all FRNs is 9.82 basis points. Furthermore, nearly 89 percent of all of the premium estimates are positive.

One way of evaluating the economic importance of these results is by estimating the total value of the premium across all FRNs. To do this, we multiply the average price premium for each FRN by the total par amount issued. This

[10]The premia for the last four FRNs issued are not computed since their maturities exceed one year throughout the sample period and, therefore, cannot yet be replicated by Treasury bills.

simple calculation implies that the total valuation effect of the premium is \$309 million relative to Treasury bills, and \$992 million relative to the Treasury notes. These valuation effects are very significant from an economic perspective.

Given the striking nature of the results, it is important to consider how the stability premia we estimate are related to the other types of liquidity and near-money premia documented in previous empirical literature. First, it should be recognized that the replication approach we use to identify the premium controls for any potential credit or rollover risk incorporated into Treasury security prices. There are two reasons for this. Both the FRN and the replicating portfolio of Treasury securities are guaranteed by the full faith and credit of the United States. Thus, the underlying credit risk of the FRN and the replicating Treasury securities is held fixed in the estimation. In addition, by matching the maturity of the replicating portfolio to that of the FRN, our approach also holds fixed the rollover risk of the securities. These considerations imply that the premium we estimate is likely to be different from the safety premium in Treasury security prices documented by Krishnamurthy and Vissing-Jorgensen (2012) and others.

Second, the liquidity characteristics of the FRNs and matched-maturity Treasury bills and notes we use to estimate the premia are very similar. To illustrate this, Table 4 provides summary statistics for a number of liquidity measures for the FRNs and the corresponding Treasury bills and notes. Specifically, Table 4 shows that the three types of securities mirror each other closely in terms of their total amounts issued, average bid-ask spreads, and bid-to-cover ratios at the initial auction of the issues. The similarity in these liquidity measures suggests that the premium we estimate is also unlikely to be the same as the liquidity premium identified in the prices of Treasury securities by Amihud and Mendelson (1991), Kamara (1994), Longstaff (2004), Krishnamurthy and Vissing-Jorgensen (2012), and others.

Third, the stability premium is also unlikely to be related to the on-the-run/off-the-run effect studied by Krishnamurthy (2002). Specifically, in estimating the premium relative to Treasury bills, we use the most-recently-issued Treasury bills in the replication. Thus, we compare off-the-run FRNs to on-the-run or recently-issued Treasury bills. This means that finding a positive premium would be inconsistent with the on-the-run/off-the-run effect since it goes in the opposite direction. Furthermore, in comparing swapped FRNs with two-year Treasury notes, we are comparing one on-the-run security with another on-the-run security. As discussed earlier, the auction dates for the FRNs and the matched-maturity two-year Treasury notes are typically within a day or so of each other. This means that both the FRNs and the matched Treasury notes used in the estimation are on-the-run at the same time. Thus, if there is a premium in FRN prices when measured relative to Treasury notes, then that premium is likely different from the familiar on-the-run/off-the-run liquidity effect.

Fourth, the stability premium differs from the near-money liquidity premium in Treasury bill yields documented by Nagel (2016). In particular, he finds that there is a significant spread between the three-month general collateral government repo rate and the three-month Treasury bill rate. Since fully-collateralized government repo is essentially default free, this spread represents an additional liquidity premium for the near-money properties of Treasury bills relative to collateralized lending agreements such a repo loans. To establish this point, we will regress changes in the premia on changes in the repo/Treasury-bill spread later in the analysis. We find that there is no significant relation between the two measures, implying that the premium we estimate is distinct from that identified by Nagel (2016).

Finally, an important advantage of the approach we use is that swapping the FRN into synthetic fixed rate debt allows us to make a clean apples-to-apples comparison to other Treasury securities with identical cash flows. In the absence of arbitrage, of course, the swapped FRN and the replicating portfolio should have the same value. In light of this, the premium can be viewed as representing the additional value (above and beyond the present value of their cash flows) that economic agents are willing to place on near-money assets with prices that are nearly constant.

7. CROSS-SECTIONAL PROPERTIES

If the estimated premium in FRN prices is in fact related to the role of these securities as a more-stable store-of-value vehicle relative to other Treasury securities, then we would expect that the cross-section of premia should be related to the relative magnitude of the price fluctuations between the FRNs and the corresponding replicating portfolios of Treasury securities.[11]

To examine these empirical implications, Table 5 reports summary statistics for the premia stratified by time to maturity. As shown, the average premia are positive and statistically significant across all maturity categories for premia measured relative to both Treasury bills and notes. Furthermore, the percentages of positive premia are substantially higher than 50 percent across all of the maturity categories.

The table indicates that there is a clear relation between the average premia

[11] For a discussion of the interest rate sensitivity of floating rate notes, see Fabozzi and Mann (2000) and Cochrane (2015).

and the maturity of the FRN. For the premia measured relative to Treasury bills, the lowest average is for the 3- to 4-month category, while the highest average is for 9- to 12-month category. For the premia measured relative to Treasury notes, the averages typically increase in maturity up to about 15 months, but then decline slightly for longer maturities. Thus, while there is a general positive relation between the average premia and maturity, this relation is not always exclusively monotonically increasing. We note, however, that one reason for this non-monotonicity is that we are expressing the premium in terms of yields rather than prices. In contrast, the relation between average price premia and maturity is virtually monotonically increasing.

To provide some additional perspective on the cross-sectional structure of the stability premia, Figures 2 and 3 present three-dimensional plots of the price premia as functions of time to maturity over the sample period. As shown, price premia are strongly related to the maturity of the FRNs and corresponding matched Treasury bills and notes. In particular, there is a strong positive correlation between the price premium and the time to maturity of the FRN for the large majority of days in the sample period.

To examine the cross-sectional relation between the premia and the volatilities of the underlying securities more formally, we use a simple panel regression approach. Specifically, we compute the standard deviation of daily price changes for each FRN for each month during the sample period, and do the same for the matched-maturity Treasury bills and notes used in the replication. We also compute the monthly averages of the price premia. We then regress the monthly averages of the price premia on the differences in the standard deviations of price changes for the FRNs and the matched-maturity Treasury bills or notes. To control for time-series variation, we include monthly fixed effects in the panel regression.

The results from these panel regressions, shown in Table 6, provide strong evidence that the premia are directly related to the relative price volatility of the FRNs and Treasury bills and notes. In particular, the coefficient for the difference in volatilities (measured in cents per $100 par amount) is 7.237 with a t-statistic of 4.71 in the regression for premia measured relative to Treasury bills, and 2.289 with a t-statistic of 6.26 in the regression for premia measured relative to Treasury notes. These intuitive results are consistent with premia representing the additional value investors are willing to pay for the nearest-to-money near-money assets.

8. TIME-SERIES PROPERTIES

The three-dimensional plots in Figures 2 and 3 also indicate that there is considerable variation in the premia over time. To show this more clearly, we construct indexes of the premia by taking simple averages of the premia across FRNs for each date in the sample. We construct separate indexes for the premia measured relative to Treasury bills and for premia measured relative to Treasury notes and denote them as the FRN/T-bill and FRN/T-note indexes, respectively.

As discussed earlier, the premia may reflect the additional value that investors place on FRNs relative to other near-money assets because of the unique role they play as a store-of-value or capital-preservation option. In that case, we would anticipate that changes in the premia would be related to changes in investor demand for safe assets. To explore this hypothesis, our approach is to regress changes in the indexes on several categories of explanatory variables. In particular, we focus on a number of explanatory variables motivated by the literature on safe assets, systemic risk, and market liquidity. We acknowledge, of course, that this regression approach does not allow us to make definitive causal statements about the source of the premia. Despite this, however, we believe that this approach represents an important first step towards identifying relationships between the premia and other fundamental variables, and providing intuition about potential underlying economic mechanisms. The Online Appendix describes the data sources and definitions of these variables.

The first of these variables is the near-money liquidity premium in short-term Treasury securities studied by Nagel (2016). He estimates this liquidity premium as the difference between the three-month general collateral government repo rate and the three-month Treasury bill rate. We include this variable as a way to examine whether the premia we estimate are different from the Nagel (2016) near-money liquidity premium.

The second category of variables is also motivated by Nagel (2016) who presents a model in which the premium in near-money assets is directly related to the opportunity cost of holding money. He shows that the near-money liquidity premium in Treasury bills is significantly related to the level of short-term interest rates. Furthermore, he shows that this relation subsumes many of the supply effects previously documented in the literature. Paralleling Nagel (2016), we include the three-month Libor rate as a measure of the short-term opportunity cost of holding money. To capture potential longer-horizon opportunity costs, we also include the one-year constant maturity Treasury rate in the analysis.

The third category is motivated by Brunnermeier and Pedersen (2009) who present a model in which funding frictions faced by dealers in the financial markets can generate liquidity premia in security prices. Similar implications emerge from other theoretical models such as Xiong (2001), Gârleanu and Pedersen (2011), and others. Following Cui, In, and Maharaj (2016), Schwartz (2017), and others, we use the OIS spread as a proxy for dealer funding illiquidity. This spread is computed as the difference between the three-month Libor rate and the three-money OIS swap rate (which is tied to the overnight fed funds rate).

The fourth category consists of several key volatility measures. The inclusion of volatility measures in the analysis is also motivated by the previous literature. The first measure is the VIX index of stock market volatility implied from options on the S&P 500 Stock Index. The second is the volatility of inflation implied from the prices of ten-year inflation straddles (put and call options with the same strike price) actively traded in the over-the-counter interest rate derivatives market.[12]

The fifth category measures the flow of investor funds into money market mutual funds. The intuition for including this category is that we would expect investors concerned about financial safety to allocate more funds to liquid short-term money substitutes such as money market mutual funds. This intuition is consistent with recent results by Strahan and Tanyeri (2015) and Schmidt, Timmermann, and Wermers (2016). Specifically, we include the weekly flows into Treasury money market mutual funds which are funds that hold primarily short-term Treasury securities. We denote these as Treasury money market flows. We also include the weekly flows into other types of money market mutual funds which may hold larger proportions of other types of short-term liquid assets. We designate these as non-Treasury money market flows.

Finally, we include several other variables that proxy for "flight" risk—the risk that a systemic shock to the financial markets leads to a flight-to-quality or a flight-to-liquidity in which there is a large increase in the demand for safe assets. In particular, we include changes in the credit default swap (CDS) spread for contracts protecting against the default of the U.S Treasury. Similarly, we include changes in the average CDS spread for a set of major Wall Street dealers. We also include changes in the Bloomberg U.S. Dollar Index which is calculated by averaging the exchange rates between the dollar and major world currencies. Lastly, we include changes in an index of the prices of precious metals (gold, silver, and platinum). Flights-to-quality and flights-to-liquidity are discussed in Longstaff (2004), Beber, Brandt, and Kavajecz (2009), and others. Table 7 reports the results from the regression of weekly changes in the two indexes on the corresponding changes in the explanatory variables.

As shown, changes in the repo spread measure are not significant in either the

[12]See Fleckenstein, Longstaff, and Lustig (2017) for a discussion of the inflation options market.

FRN/T-bill or FRN/T-note index regressions. This indicates that the stability premium in FRN prices is not the same as the near-money liquidity premium in Treasury bill prices studied in Nagel (2016). This result is important since it suggests that financial markets value multiple facets of safe assets. This is consistent with the view that money plays a variety of fundamental roles in the economy.

The three-month Libor rate is not significant in either regression. However, the one-year rate is highly significant in both the FRN/T-bill and FRN/T-note index regressions. In particular, the coefficients for the change in the one-year rate are positive with t-statistics of 3.91 and 3.88, respectively. These results provide support for Nagel (2016) who argues that near-money premia should be directly related to the opportunity cost of holding money. Our results also extend his results by showing that the opportunity costs associated with longer-horizon Treasury securities also influence the near-money premium that market participants place on them.

The coefficients for the OIS spread are positive and significant in both regressions. This result is consistent with investors placing a larger premium on FRNs at times when market participants face greater liquidity and funding uncertainty. This intuitive result is also consistent with the implications of a number of recent models that focus on the role that intermediaries play in financial markets. For example, see Gromb and Vayanos (2002), Brunnermeier and Pedersen (2009), and Gârleanu and Pedersen (2011).

Table 7 provides strong support for the hypothesis that the stability premium is related to the amount of uncertainty in the financial markets. In particular, both measures of volatility have significant explanatory power for changes in the indexes. These results are again intuitive since we would expect that investors place a greater value on the safety of near-money assets precisely when the values of other investments begin to fluctuate more.

The results also show that there is a significant relation between the FRN/T-note index and flows into both types of money market mutual funds. In particular, the coefficient for flows into Treasury money market funds is positive and significant at the five-percent level, while the coefficient for flows into non-Treasury money market funds is positive and significant at the ten-percent level. These results suggest a direct link between near-money premia and investor demand for safe assets. Flows into money market funds are not significant for the FRN/T-bill index. Finally, none of the additional flight-risk variables are significant in the regressions.

9. ROBUSTNESS RESULTS

In this section, we present robustness results showing that the results are not due to swap mispricing or the daily interest rate accrual floor for FRNs.

9.1 Are the Results Due to Swap Mispricing?

The results indicate that swapped FRNs trade at a premium relative to fixed rate Treasury bills and notes. A natural question that arises, however, is whether the results are due to the actual pricing of the FRNs, or to the possibility that the swaps used in our estimation approach may themselves be mispriced. If the results are due to the presence of a unique near-money premium in FRN prices, then we would not expect to find the same type of premia in the prices of other floating rate securities when the same set of swap prices is used in the analysis. On the other hand, if the results are due to swap mispricing instead, then our methodology would lead to spurious evidence of premia in other types of floating rate securities in which we would not expect a near-money premium.

To test the robustness of our results to the possibility of swap mispricing, we apply our methodology to two alternative classes of floating rate notes. For the first, we collect data on matched-maturity pairs of floating and fixed rate corporate notes during the 2014 to 2018 study period. We then swap the floating rate corporate notes into fixed rate corporate debt using the same data set of swap prices used in swapping FRNs into fixed rate Treasury debt. Finally, we compare the yield on the swapped corporate floating rate notes with the yield on the replicating portfolio of fixed rate corporate debt.

We find no evidence of systematic pricing differences between the swapped floating rate and fixed rate corporate bonds. In particular, the average yield difference across all 38 pairs of matched-maturity floating and fixed rate corporate notes is -0.13 basis points which is not statistically significant. In addition, the median yield difference is only -0.06 basis points. Furthermore, the yield differences are nearly evenly divided between positive and negative values; 50.35 percent of the yield differences are positive. Thus, when we use the same swap rate data that we use in estimating the stability premium in Treasury FRNs, we find no significant differences between swapped floating rate and fixed rate corporate debt. These results suggest that swap mispricing is not the reason why swapped FRNs trade at a premium to fixed rate Treasury notes.

Second, we also collect data on 32 pairs of matched-maturity floating rate and fixed rate Federal Farm Credit Bank securities and use the same swap rates and methodology as before. We again find that the average difference in yields across all pairs is small. In fact the average difference of -3.08 basis points has the opposite sign to the averages for the FRNs. This provides additional evidence that the estimated premia for FRNs are not simply artifacts of the mispricing of the swaps.

The results described above for the premia computed for corporate bonds and Federal Farm Credit Bank bonds are summarized in the Online Appendix. As an additional robustness check, we also compare the average Treasury-bill/Libor basis swap spreads with the realized Treasury-bill/Libor spread. The average basis swap spreads during the 2014–2018 sample period are 30.25, 31.13, 32.36, and 33.69 basis points for the 6-, 12-, 18-, and 24-month tenors, respectively (see the Online Appendix). These values are all very close to the realized Treasury-bill/Libor spread of 30.86 basis points over the same period. Thus, the swaps appear to be priced fairly in terms of economic fundamentals.

9.2 Are the Results Due to the Interest Rate Accrual Floor?

As described earlier, the daily interest rate accrual for FRNs is floored at zero. In theory, this raises the possibility that there could be a small option premium embedded into the prices of FRNs to reflect the value of this floor. In reality, there are a number of reasons why such a premium would be negligible. First, if there was a floor premium, its value would be negatively correlated with the level of Treasury bill rates, since the option moves deeper out of the money as rates increase. In contrast, we find that there is a strong positive correlation of 0.441 between the average premium and the level of Treasury bill rates during the sample period. Second, the largest values of the average premium occur when the Treasury bill rate is near its highest values during the sample period. Third, the results in Table 7 confirm that the premium is positively related to the level of Treasury interest rates. Finally, the historical record shows that three-month Treasury bill auction rates have rarely, if ever, been negative. Thus, it is unlikely that market participants would place any material probability weight on negative realizations for three-month Treasury bill auction rates.

10. CONCLUSION

Money serves three key roles as a medium of exchange, a store of value, and as a unit of account. Near-money assets such as Treasury securities can play similar roles in the economy. In particular, the high liquidity of Treasury securities ensures that they can readily be converted into money, either through direct sale or through collateralized financing transactions such as tri-party or GCF repo contracts. Similarly, the full faith and credit guarantee of U.S. Treasury securities allows them to serve as safe havens during flights-to-quality and global financial crises.

In this paper, we extend the literature on the pricing of safe assets by showing that agents place an additional premium on the near-money assets whose nominal prices fluctuate the least. In particular, we use a no-arbitrage replication approach to show that Treasury FRNs are valued at a significant premium to matched-maturity fixed rate Treasury bills and notes. This premium is directly related to the stability of FRN prices relative to those of the matched-maturity Treasury bills and notes. Since the stability of FRN prices ensures that they can always be converted or financed via repo into money at or close to their par value, this additional premium can be interpreted as a price-stability or store-of-value premium. We show that this premium is distinct from the liquidity, safety, and on-the-run premia previously documented in the literature. Furthermore, we show that the stability premia are related to measures that proxy for the demand by investors for safe assets.

These results also have important implications for Treasury debt management. In particular, they raise the possibility that the Treasury could reduce its cost of debt financing significantly—without increasing the rollover risk of its debt portfolio—by issuing debt securities such as FRNs with values that fluctuate far less than other Treasury securities.

REFERENCES

Amihud, Yakov, and Haim Mendelson, 1991, Liquidity, Maturity, and the Yields on U.S. Treasury Securities, Journal of Finance 46, 1411-1425.

Bhanot, Karan, and Liang Guo, 2017, The New Market for Treasury Floating Rate Notes, The Journal of Fixed Income 27 (2), 52-64.

Brunnermeier, Markus K., and Lasse Heje Pedersen, 2009, Market Liquidity and Funding Liquidity, Review of Financial Studies 22, 2201-2238.

Caballero, Ricardo J, Emmanuel Farhi, and Pierre-Olivier Gourinchas, 2008, An Equilibrium Model of Global Imbalances and Low Interest Rates, American Economic Review 98, 358-393.

Caballero, Ricardo J., and Arvind Krishnamurthy, 2009, Global Imbalances and Financial Fragility, American Economic Review 99, 584-588.

Cochrane, John H., 2015, A New Structure for U.S. Federal Debt, Hoover Institution, Economics Working Paper 15108.

Cui, Jin, Francis In, and Elizabeth Ann Maharaj, 2016, What Drives the Libor-OIS Spread? Evidence from Five Major Currency Libor-OIS Spreads, International Review of Economics & Finance 45, 358-375.

Dang, Vi Tri, Gary Gorton, and Bengt Holmström, 2015, Ignorance, Debt and Financial Crises, Columbia University Working Paper.

Duffee, Gregory R., 1996, Idiosyncratic Variation of Treasury Bill Yields, Journal of Finance 51, 527-551.

Duffie, Darrell, 2015, Discussion of 'A New Structure for U.S. Federal Debt' by John H. Cochrane, Brookings Institution Press.

Fabozzi, Frank J., and Steven V. Mann, 2000, *Floating-Rate Securities*, Frank J. Fabozzi Associates, New Hope, PA.

Fleckenstein, Matthias, Francis A. Longstaff, and Hanno Lustig, 2014, The TIPS-Treasury Puzzle, Journal of Finance 69, 2151-2197.

Fleckenstein, Matthias, Francis A. Longstaff, and Hanno Lustig, 2017, Deflation Risk, Review of Financial Studies 30, 2719-2760.

Gârleanu, Nicolae, and Lasse H. Pedersen, 2011, Margin-Based Asset Pricing and Deviations from the Law of One Price, Review of Financial Studies 22, 4259-4299.

Gorton, Gary, and Guillermo L. Ordoñez, 2013, The Supply and Demand for Safe Assets, NBER Working Paper No. 18732.

Greenwood, Robin, Samuel Hanson, and Jeremy C Stein, 2010, A Gap-Filling Theory of Corporate Debt Maturity Choice, Journal of Finance 65, 993-1028.

Greenwood, Robin, Samuel G. Hanson, and Jeremy C. Stein, 2015, A Comparative-Advantage Approach to Government Debt Maturity, The Journal of Finance 70, 1683-1722.

Greenwood, Robin, and Dimitri Vayanos, 2014, Bond Supply and Excess Bond Returns, Review of Financial Studies 27, 663-713.

Gromb, Denis, and Dimitri Vayanos, 2002, Equilibrium and Welfare in Markets with Financial Constrained Arbitrageurs, Journal of Financial Economics 66, 361-407.

Guibaud, Stephane, Yves Nosbusch, and Dimitri Vayanos, 2013, Bond Market Clienteles, the Yield Curve, and the Optimal Maturity Structure of Government Debt, Review of Financial Studies 26, 1914-1961.

Hartley, Jonathan, and Urban J. Jermann, 2018, Should the U.S. Government Issue Floating Rate Notes?, Wharton School Working Paper.

He, Zhiguo, Arvind Krishnamurthy, and Konstantin Milbradt, 2016a, A Model of Safe Asset Determination, NBER Working Paper No. 22271.

He, Zhiguo, Arvind Krishnamurthy, and Konstantin Milbradt, 2016b, What Makes US Government Bonds Safe Assets?, American Economic Review 106, 519-523.

He, Zhiguo, and Wei Xiong, 2012, Rollover Risk and Credit Risk, Journal of Finance 67, 391-429.

Kamara, Avraham, 1994, Liquidity, Taxes, and Short-Term Treasury Yields, Journal of Financial and Quantitative Analysis 29, 403.

Krishnamurthy, Arvind, 2002, The Bond/Old Bond Spread, Journal of Financial Economics 66, 463-506.

Krishnamurthy, Arvind, and Annette Vissing-Jorgensen, 2012, The Aggregate Demand for Treasury Debt, Journal of Political Economy 120, 233-267.

Lewis, Kurt, Francis Longstaff, and Lubomir Petrasek, 2017, Asset Mispricing, NBER Working Paper No. 23231.

Longstaff, Francis A., 2004, The Flight-to-Liquidity Premium in U.S. Treasury

Bond Prices, Journal of Business 77, 511-526.

Musto, David, Greg Nini, and Krista Schwarz, 2018, Notes on Bonds: Liquidity at all Costs During the Great Recession, Review of Financial Studies 31, 2983-3018.

Nagel, Stefan, 2016, The Liquidity Premium of Near-Money Assets, Quarterly Journal of Economics 131, 1927-1971.

Newey, Whitney K., and Kenneth D. West, 1987, A Simple, Positive Semi-Definite Heteroskedasticity and Autocorrelation Consistent Covariance Matrix, Econometrica 55, 703-708.

Schmidt, Lawrence, Allan Timmermann, and Russ Wermers, 2016, Runs on Money Market Mutual Funds, American Economic Review 106, 26252657.

Schwarz, Krista, 2017, Mind the Gap: Disentangling Credit and Liquidity in Risk Spreads, Wharton School Working Paper.

Strahan, Philip E., and Basak Tanyeri, 2015, Once Burned, Twice Shy: Money Market Fund Responses to a Systemic Liquidity Shock, Journal of Financial and Quantitative Analysis 50, 119-144.

Vayanos, Dimitri, and Pierre-Olivier Weill, 2008, A Search-Based Theory of the On-the-Run Phenomenon, Journal of Finance 63, 1361-1398.

Xiong, Wei, 2001, Convergence Trading with Wealth Effects: An Amplification Mechanism in Financial Markets, Journal of Financial Economics 62, 247-292.

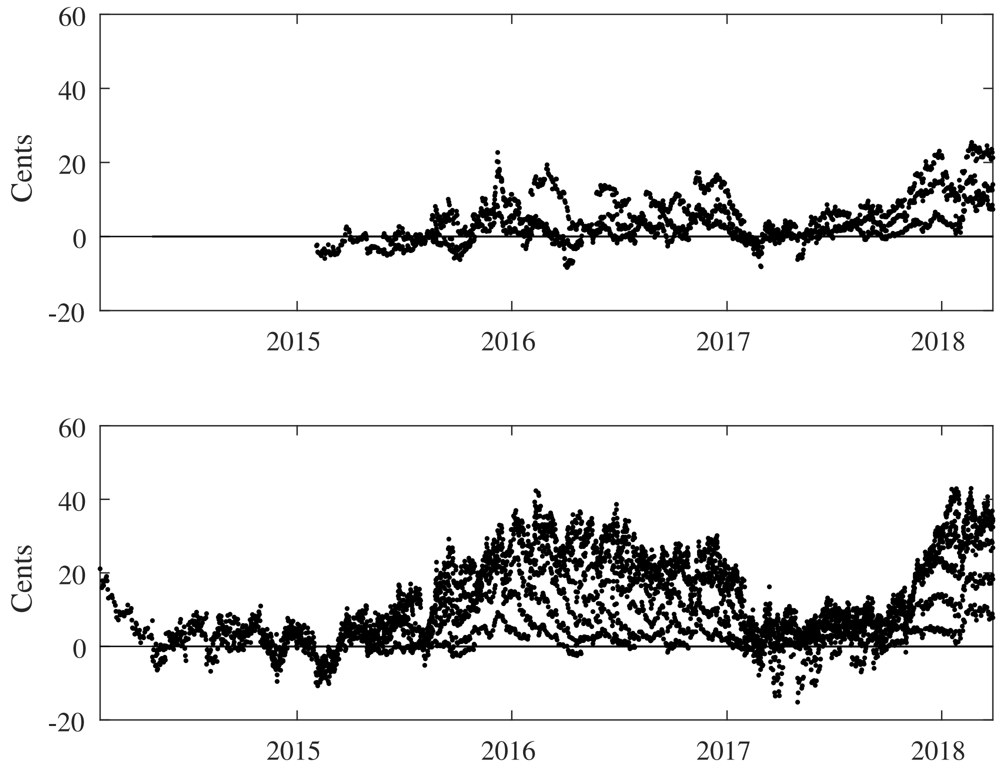

Figure 1. Price Premia. The top panel plots the time series of the price premia measured relative to Treasury bills. The lower panel plots the time series of the price premia measured relative to Treasury notes. The price premia are expressed in cents per $100 par amount.

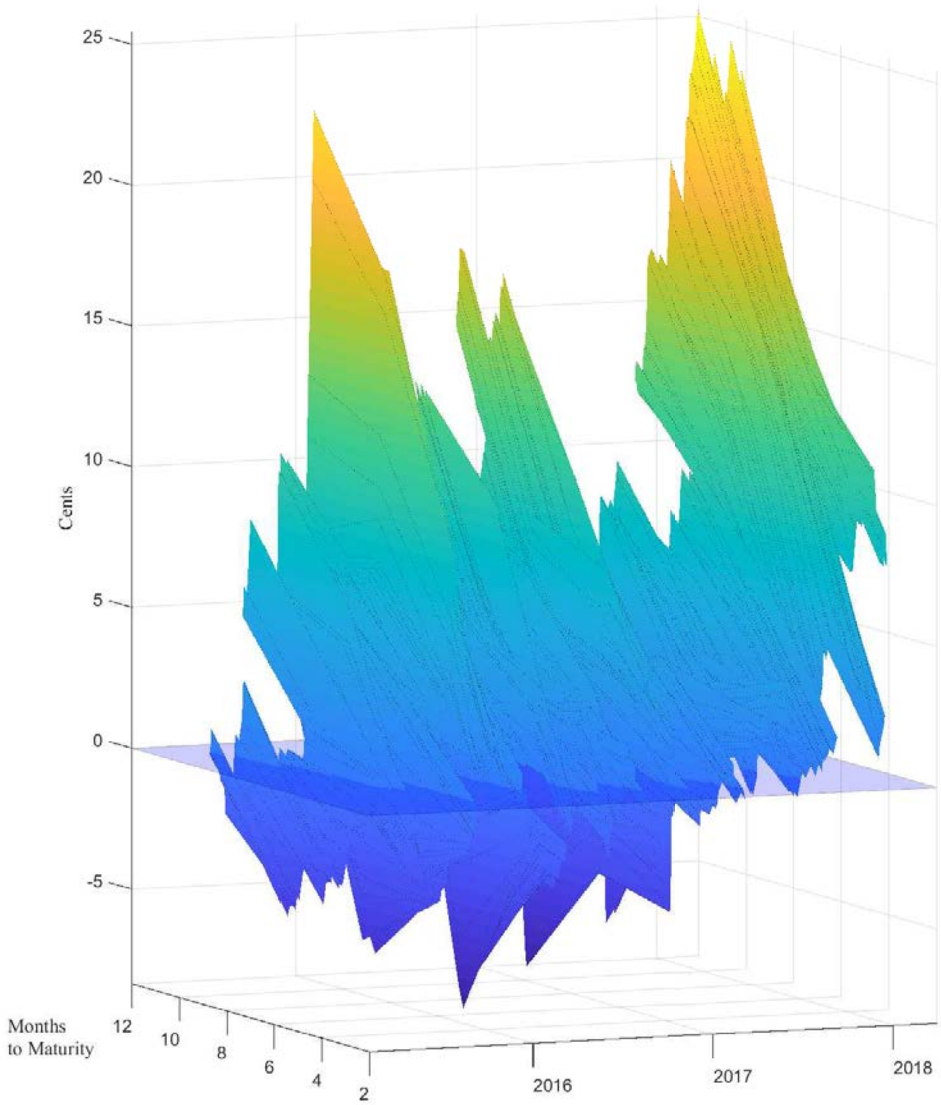

Figure 2. Time Series of Price Premia Measured Relative to Treasury Bills by Time to Maturity. This figure plots the time series of the price premia measured relative to Treasury bills as a function of the time to maturity for the FRNs. Price premia are expressed as cents per $100 par amount.

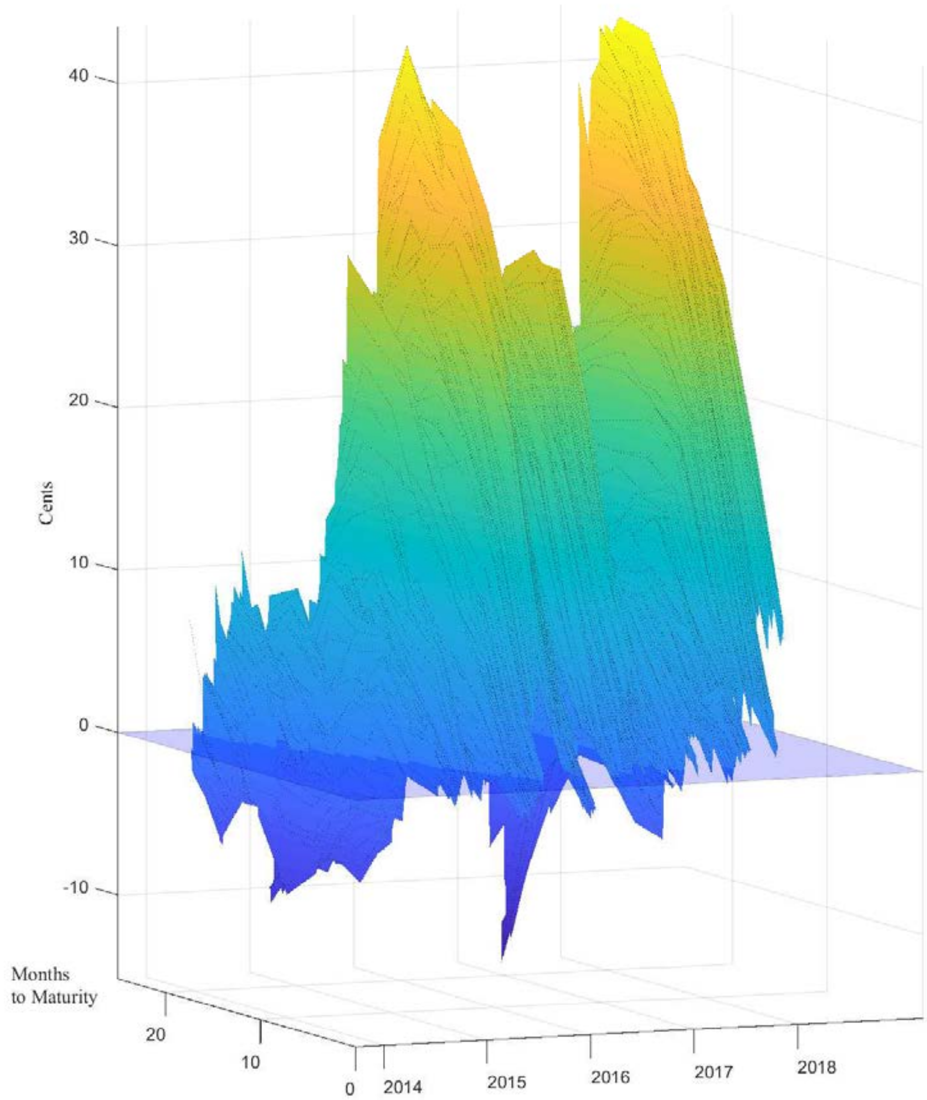

Figure 3. Time Series of Price Premia Measured Relative to Treasury Notes by Time to Maturity. This figure plots the time series of the price premia measured relative to Treasury notes as a function of the time to maturity for the FRNs. Price premia are expressed as cents per $100 par amount.

Table 1

Summary Statistics for Treasury Floating Rate Note Prices. This table presents summary statistics for the clean prices (without accrued coupon) of the two-year Treasury FRNs issued during the sample period. The FRN spread is measured in basis points. The summary statistics are based on prices for the FRNs from their issue date until three months before their maturity date. N denotes the number of observations. The sample period is daily from January 31, 2014 to March 29, 2018.

FRN	Maturity	Spread	Mean	Std Dev	Min	Median	Max	N
1	1–31–2016	4.50	99.992	0.015	99.953	99.997	100.022	456
2	4–30–2016	6.90	100.017	0.013	99.992	100.015	100.055	457
3	7–31–2016	7.00	100.017	0.015	99.984	100.012	100.062	454
4	10–31–2016	5.30	99.987	0.021	99.900	99.991	100.016	455
5	1–31–2017	8.40	100.017	0.022	99.933	100.022	100.063	441
6	4–30–2017	7.40	99.990	0.050	99.766	100.003	100.045	452
7	7–31–2017	7.70	99.981	0.075	99.673	100.002	100.083	444
8	10–31–2017	16.80	100.069	0.081	99.725	100.099	100.169	446
9	1–31–2018	27.20	100.202	0.064	100.042	100.224	100.309	453
10	4–30–2018	19.00	100.131	0.055	99.979	100.129	100.219	450
11	7–31–2018	17.40	100.131	0.060	99.987	100.143	100.234	411
12	10–31–2018	17.00	100.156	0.067	99.997	100.172	100.252	343
13	1–31–2019	14.00	100.155	0.054	99.996	100.173	100.226	297
14	4–30–2019	7.00	100.073	0.040	99.983	100.078	100.145	235
15	7–31–2019	6.00	100.068	0.045	100.000	100.075	100.151	174
16	10–31–2019	4.80	100.061	0.032	100.000	100.069	100.115	107
17	1–31–2020	0.00	99.980	0.015	99.928	99.978	100.000	41
All	—	—	100.060	0.088	99.673	100.029	100.309	6,116

Table 2

Volatility of Daily Changes in Treasury Security Prices. This table reports the standard deviation of daily price changes for FRNs where the results are stratified based on the number of months to maturity for the FRNs. The table also reports the standard deviation of daily price changes for Treasury bills and two-year Treasury notes with maturity dates matched to those of the individual FRNs. The standard deviations are computed using only data for days on which price change observations are available for the individual FRN as well as both the matched-maturity Treasury bill and two-year Treasury note (or only the two-year Treasury note for horizons longer than one year). Standard deviations are expressed as cents per $100 notional. The sample period is daily from January 31, 2014 to March 29, 2018.

Months to Maturity					
From	To	FRN	T-Bill	T-Note	*N*
3	4	0.189	0.381	0.468	209
4	5	0.251	0.639	0.690	247
5	6	0.262	0.644	0.659	237
6	9	0.354	0.926	0.911	743
9	12	0.422	1.358	1.251	798
12	15	0.589	—	1.890	863
15	18	0.659	—	3.262	903
18	21	0.652	—	4.199	983
21	24	0.783	—	5.025	1,026

Table 3

Summary Statistics for the Premia. This table presents summary statistics for the premia in FRN prices measured relative to Treasury bills and Treasury notes. The premia are computed as the difference between the yield on the replicating portfolios using matched-maturity Treasury bills or notes and the yield on the swapped FRN. Yield differences are measured in basis points. A positive yield difference implies that the yield on the replicating portfolio is higher than the yield on the swapped FRN. Std Dev denotes the standard deviation. N denotes the number of observations. The sample period is daily from January 31, 2014 to March 29, 2018.

		Relative to T-Bills						Relative to T-Notes					
FRN	Maturity	Mean	Std Dev	Min	Max	Percent Positive	N	Mean	Std Dev	Min	Max	Percent Positive	N
1	1–31–2016	−4.31	2.85	−11.25	3.09	6.70	194	0.62	3.17	−8.01	10.59	56.36	456
2	4–30–2016	1.99	5.45	−10.96	21.26	66.29	178	3.87	5.04	−6.48	23.46	80.74	457
3	7–31–2016	6.25	7.94	−11.76	27.85	84.24	184	5.72	8.23	−8.88	34.08	79.30	454
4	10–31–2016	2.22	6.72	−14.65	25.46	63.30	188	8.39	8.14	−4.46	33.70	89.89	455
5	1–31–2017	6.61	5.92	−7.33	21.20	89.67	184	9.86	8.52	−5.42	31.30	90.48	441
6	4–30–2017	7.15	4.64	−4.88	15.83	92.18	179	12.37	6.80	−2.76	27.91	96.68	452
7	7–31–2017	5.28	6.38	−11.28	16.03	73.91	184	12.86	7.69	−10.26	26.18	91.44	444
8	10–31–2017	6.33	6.15	−6.24	19.11	85.19	189	14.13	6.60	−5.28	24.85	97.98	446
9	1–31–2018	0.95	3.28	−8.89	7.22	66.67	195	12.29	6.66	−3.29	25.86	97.13	453
10	4–30–2018	7.76	3.16	2.62	18.45	100.00	181	11.26	4.57	−0.24	22.21	99.78	450
11	7–31–2018	15.75	6.72	5.08	29.07	100.00	162	11.07	6.38	−1.44	29.13	98.54	411
12	10–31–2018	18.68	5.07	1.46	27.73	100.00	103	12.14	9.44	−3.16	34.13	95.92	343
13	1–31–2019	23.61	4.11	12.58	28.53	100.00	42	10.30	12.03	−7.30	34.56	81.14	297
14	4–30–2019	—	—	—	—	—	—	10.91	12.28	−7.71	33.38	83.40	235
15	7–31–2019	—	—	—	—	—	—	12.27	10.91	−3.64	30.46	81.03	174
16	10–31–2019	—	—	—	—	—	—	16.99	6.90	−0.80	26.66	99.07	107
17	1–31–2020	—	—	—	—	—	—	17.34	2.40	10.87	21.75	100.00	41
All		5.92	8.15	−14.65	29.07	76.28	2,163	9.82	8.59	−10.26	34.56	88.65	6,116

Table 4

Liquidity Measures for Treasury Floating Rate Notes and Matched-Maturity Treasury Bills and Notes. This table reports the total amount issued, the bid-ask spread, and the bid to cover ratio for the two-year FRNs issued during the sample period, along with the same measures for the matched-maturity Treasury bills and two-year Treasury notes. Amount issued denotes the total par amount issued by the Treasury and is measured in billions of dollars. Bid-ask spread denotes the average bid-ask spread in cents per 100 dollar par amount of the indicated securities. Bid to cover denotes bid to cover ratio for the security at the initial auction. The sample period is daily from January 31, 2014 to March 29, 2018.

		Amount Issued			Bid-Ask Spread			Bid to Cover		
FRN	Maturity	FRN	T-Bill	T-Note	FRN	T-Bill	T-Note	FRN	T-Bill	T-Note
1	1–31–2016	41.00	25.00	32.00	0.377	0.334	1.115	5.67	3.81	3.30
2	4–30–2016	41.00	25.00	32.00	0.358	0.324	1.116	4.69	4.11	3.35
3	7–31–2016	41.01	25.00	29.01	0.355	0.372	1.113	4.45	3.37	3.22
4	10–31–2016	41.00	12.00	29.00	0.378	0.340	1.114	4.00	4.03	3.11
5	1–31–2017	41.00	18.00	26.00	1.158	0.325	1.254	4.34	3.59	3.74
6	4–30–2017	41.05	20.00	26.10	1.134	0.327	1.113	4.01	3.17	3.30
7	7–31–2017	41.00	20.00	26.00	1.114	0.323	1.102	3.93	3.65	3.42
8	10–31–2017	41.00	20.00	26.00	1.121	0.339	1.098	3.48	3.35	3.01
9	1–31–2018	41.27	20.00	26.47	1.136	0.415	1.112	3.67	3.48	2.90
10	4–30–2018	44.99	20.00	32.91	1.123	0.642	1.103	3.57	3.23	2.64
11	7–31–2018	42.84	20.00	27.82	1.163	0.873	1.141	3.82	3.17	2.52
12	10–31–2018	41.91	20.00	27.57	1.285	1.170	1.252	3.80	3.34	2.53
13	1–31–2019	43.53	20.00	27.65	1.419	1.008	1.386	3.43	3.36	2.68
14	4–30–2019	44.63	—	29.55	1.537	—	1.506	3.35	—	2.85
15	7–31–2019	42.53	—	28.64	1.666	—	1.631	3.46	—	3.06
16	10–31–2019	42.38	—	26.65	1.784	—	1.736	3.69	—	2.74
17	1–31–2020	49.85	—	29.82	1.899	—	1.852	3.38	—	3.22

Table 5

Summary Statistics for the Premia Stratified by Months to Maturity. This table presents summary statistics for the premia in FRN prices measured relative to Treasury bills and Treasury notes, where the premia are stratified by number of months to maturity for the FRNs. The premia are computed as the difference between the yield on the replicating portfolios using matched-maturity Treasury bills or notes and the yield on the swapped FRN. Yield differences are measured in basis points. A positive yield difference implies that the yield on the replicating portfolio is higher than the yield on the swapped FRN. Std Dev denotes the standard deviation. N denotes the number of observations. The sample period is daily from January 31, 2014 to March 29, 2018.

Months to Maturity		Relative to T-Bills						Relative to T-Notes					
From	To	Mean	Std Dev	Min	Max	Percent Positive	N	Mean	Std Dev	Min	Max	Percent Positive	N
3	4	0.92	6.08	−11.76	15.93	57.42	209	3.48	6.37	−8.88	19.17	68.42	209
4	5	4.97	8.34	−11.25	29.07	70.45	247	7.73	7.90	−7.72	29.13	87.85	247
5	6	4.81	6.36	−11.28	24.22	79.75	237	6.37	6.19	−10.26	26.62	86.92	237
6	9	5.40	8.33	−14.65	27.85	75.53	748	10.71	8.05	−5.28	34.13	91.71	748
9	12	8.60	7.98	−8.89	28.53	83.33	722	13.34	8.85	−5.18	34.56	95.04	826
12	15	—	—	—	—	—	—	12.79	9.17	−6.48	33.38	93.01	873
15	18	—	—	—	—	—	—	11.09	8.66	−5.44	30.46	90.93	915
18	21	—	—	—	—	—	—	8.79	8.06	−5.78	27.93	87.36	997
21	24	—	—	—	—	—	—	6.38	7.00	−7.71	25.17	81.77	1,064
All		5.92	8.15	−14.65	29.07	76.29	2,163	9.82	8.59	−10.26	34.56	88.65	6,116

Table 6

Results from Panel Regressions of Average Premia on the Difference in Treasury Security Volatilities. This table reports the results from regressing the monthly averages of the price premia (expressed as cents per \$100 par amount) on the difference between the standard deviation of daily changes in the corresponding matched-maturity Treasury bill or note and the standard deviation of daily changes in the price of the FRN (the difference in standard deviations is expressed as cents per \$100 par amount). The regression includes monthly fixed effects. The t-statistics are based on the Newey-West (1987) heteroskedasticity and autocorrelation consistent estimate of the covariance matrix (four and five lags, respectively). The superscript ** denotes significance at the five-percent level. The sample period is monthly from February 2014 to March 2018.

	Relative to Treasury Bills		Relative to Treasury Notes	
Variable	Coefficient	t−Stat	Coefficient	t−Stat
Difference in Volatilities	7.2370	4.71	2.2892	6.26
Monthly Fixed Effects		Yes		Yes
Adj. R^2		0.576		0.643
N		105		286

Table 7

Results from Regressions of Changes in Premia on Explanatory Variables. This table reports the results from regressing weekly changes in the FRN/T-bill and FRN/T-note indexes of premia on changes in the indicated explanatory variables. Premia are expressed in basis points. Repo Spread denotes the weekly change in the difference between the three-month repo rate and the secondary market three-month Treasury bill rate. Libor denotes the weekly change in the three-month Libor rate. One-Year Rate denotes the weekly change in the Treasury one-year constant maturity rate. OIS Spread denotes the weekly change in the spread between the three-month Libor rate and the three-month overnight index swap rate. VIX Volatility Index denotes the weekly change in the VIX index of S&P 500 index volatility. Inflation Volatility Index denotes the weekly change in the implied basis point volatility for a ten-year inflation straddle with exercise price equal to two percent. Treasury Money Market Flows denotes the weekly net flow of funds into Treasury money market funds. Non-Treasury Money Market Flows denotes the weekly net flow of funds into non-Treasury money market funds. Treasury and non-Treasury money market flow of funds are expressed in billions of dollars. Treasury CDS denotes the weekly change in the two-year Treasury CDS spread. CDS denotes the weekly change in an index of CDS spreads for major Wall Street dealers. Dollar denotes the weekly change in the Bloomberg U.S. Dollar Index which is calculated by averaging the exchange rates between the dollar and major world currencies. Precious Metals denotes the weekly change in an index of prices for precious metals including gold, silver, and platinum. The t-statistics are based on the Newey-West (1987) heteroskedasticity and autocorrelation consistent estimate of the covariance matrix (four lags). The superscript * denotes significance at the ten-percent level; the superscript ** denotes significance at the five-percent level. The sample period is weekly from January 31, 2014 to March 29, 2018.

	FRN/T-Bill Index		FRN/T-Note Index	
Variable	Coefficient	$t-$Stat	Coefficient	$t-$Stat
Intercept	0.0642	0.26	0.0724	0.44
Repo Spread	−0.0215	−0.82	−0.0212	−1.51
Libor	−0.2487	−1.28	−0.2031	−1.33
One-Year Rate	0.3482	3.91**	0.2505	3.88**
OIS Spread	0.4064	2.20**	0.4103	2.85**
VIX Volatility Index	0.1885	2.33**	0.1225	2.21**
Inflation Volatility Index	0.0313	2.17**	0.0285	2.64**
Treasury Money Market Flows	0.0003	0.80	0.0004	2.26**
Non-Treasury Money Market Flows	0.0001	1.21	0.0001	1.87*
Treasury CDS	−0.0195	−0.15	−0.1183	−1.12
Dealer CDS	0.0399	0.91	0.0119	0.36
Dollar Index	−0.1107	−0.45	0.0420	0.24
Precious Metals	0.0001	0.01	0.0019	0.39
Adj. R^2		0.145		0.145
N		163		216

ONLINE APPENDIX

FLOATING RATE MONEY? THE STABILITY PREMIUM IN TREASURY FLOATING RATE NOTES

Matthias Fleckenstein
Francis A. Longstaff

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 an 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 submitter. The Treasury announces its auction schedule at https://www.treasury direct.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 an 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 and at maturity, FRNs are redeemed at their par amount.

For a given time t, let r_t denote the 13-week Treasury bill auction high yield from the last T-bill auction at least two business days prior to time 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. Accrued interest at time t 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 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 is $334 billion which represents 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 is $720.969 billion. Table 4 of the paper shows the total par amount for each of the FRN issues auctioned through March 2018.

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 quarterly cash flows that are calculated from the Treasury bill secondary market rate over the previous three months plus a market-determined spread F, and the other leg pays quarterly cash flows based on the three-month Libor rate set at the beginning of the three-month period. The reason for the market-determined spread is that the streams of floating cash flows from the two legs of a basis swap need not have the same present value. Thus, 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 spread F in addition to the floating cash flows. This fixed spread is known as the basis swap spread. 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 yield plus a fixed spread of 41.59 basis points, and receive quarterly floating payments based on the three-month Libor rate. To provide some perspective, Table A2 reports summary statistics for the 13-week Treasury bill/three-month Libor basis swap spreads for various tenors.

Suppose that an investor enters into a Treasury bill basis swap with notional amount of one at time zero, agreeing to pay the T-bill rate plus a fixed spread, and to receive three-month Libor L_t each quarter until the contract ends. Cash flows are calculated using standard money-market convention (actual/360). At time zero, no cash flows are exchanged. After the first three-month period at time $t = 0.25$, the investor pays the cumulative daily simple interest between $t = 0$ and $t = 0.25$ from the secondary market Treasury bill yields plus the spread. To illustrate, suppose that at time t, the Treasury bill secondary market rate is r_t. The simple interest at t is then $r_t/360$. At the end of the three-month period, the cash flow is $\sum_0^{t=.25} r_t/360 + 0.25 \times F$. Thus, the end-of-quarter cash flow $X_{0.25}$ on the T-bill leg is essentially an arithmetic average of daily Treasury bill secondary market yields from the beginning to the time of the cash flow plus the spread. In exchange for this payment, the investor receives a cash flow of $0.25 \times L_0$ at time $t = 0.25$ which is calculated from the three-month Libor rate set at $t = 0$, the beginning of the three-month period, and similarly for all subsequent quarters until the swap ends.

After executing the Treasury bill basis swap, the investor receives Libor cash flows on a quarterly basis. Finally, in order to replicate the semi-annual fixed cash flows of a Treasury note, the investor enters into a plain-vanilla interest rate swap in which the investor pays quarterly Libor and receives semi-annual fixed cash flows. The interest rate swap market is one of the largest and most liquid financial markets in existence. Around the start of our sample period in 2014, the total notional amount of outstanding contracts was $ 563 trillion, representing 81 percent of the over-the-counter global derivatives market, and the gross market value of interest rate derivatives totaled $ 13 trillion. See, OTC Derivatives Statistics at End-June 2014 at https://www.bis.org/publ/otc hy1411.pdf. The net result of taking a combined position in a Treasury bill basis swap and a standard interest rate swap is that the investor receives semi-annual fixed cash flows which is precisely the cash flow that would be received from a plain-vanilla fixed-rate semi-annual coupon bond. To provide some perspective, Table A3 reports summary statistics for the 13-week Treasury bill/fixed swap spreads for various tenors.

A.4 Swapping FRN Cash Flows into Fixed Cash Flows

To convey the intuition, we illustrate how FRNs can be swapped into fixed rate coupon debt using a simple example. In doing so, we abstract from some implementation details, and defer the discussion of these details to section A.4.1. Our methodology essentially boils down to a simple two-step approach. First, we use prices from the active basis swap market to convert the underlying index for the stream of quarterly floating coupon payments on the FRN from the 13-week Treasury bill yield to three-month Libor. Second, we use prices from the standard Libor interest rate swap market to convert the resulting stream of Libor coupon payments into semiannual fixed rate payments.

Consider an investor who purchases a two-year FRN. Table A4 shows the timing and amounts of the cash flows received by this investor, where X_t denotes the floating 13-week Treasury bill index on which quarterly coupon payments are based, and S denotes the fixed spread for the floating rate note. As described in section A.3, there is a large and actively-traded interest rate swap market in which financial institutions can exchange a stream of floating cash flows for a stream of fixed cash flows. In a standard swap, the floating leg of the swap is tied to the three-month Libor rate. However, there is also an active basis swap market that allows the institution to exchange a wide variety of floating indexes for a stream of fixed cash flows. Thus, to swap out the floating exposure to the Treasury bill index X_t, the investor simply needs to enter into a zero-cost interest rate swap in which he pays the index X_t and receives a market-determined fixed coupon rate of F.

A.4.1 Methodology

This section describes implementation details of our methodology to swap FRN cash flows into fixed cash flows. Before swapping the floating cash flows from a FRN into fixed cash flows, it is important to first take into account the differences in the daycount conventions between FRNs, basis swaps, Libor interest rate swaps, and Treasury notes. In particular, basis swaps use the actual/360 daycount convention and both legs have quarterly cash flows. Libor interest rate swaps use the actual/360 daycount convention for the quarterly cash flows on the floating leg and use the 30/360 daycount convention for the semiannual cash flows on the fixed leg. FRNs accrue interest using the actual/360 daycount convention and have quarterly cash flows. In contrast, Treasury notes accrue interest using the actual/actual daycount convention and have semiannual coupon cash flows. We control for these differences by converting all rates and spreads to actual/actual daycounts.

The first step in swapping the floating cash flows of a FRN into fixed cash flows is to enter into a T-Bill/Libor basis swap with the same maturity as the FRN. In this basis swap, we receive the floating Libor rate and pay the floating coupon from the FRN plus a fixed basis swap spread. The combination of the FRN and the basis swap creates a synthetic FRN with floating cash flows based on Libor instead of the T-bill rate. In doing this, a small adjustment is needed 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.

The second step in swapping the floating cash flows for a FRN into fixed cash flows is to enter into a standard Libor interest rate swap in which we pay floating Libor and receive fixed coupon payments. The net effect of entering this swap is to replace the stream of floating Libor coupon payments from the synthetic FRN created in the first step with a stream of quarterly fixed coupon payments. Thus, the result of these two steps is to transform the original FRN into a synthetic fixed rate Treasury note, where the coupon rate is determined by the total of the original FRN spread, the fixed basis swap spread, and the interest rate swap rate.

When the maturity of the FRN is an integer multiple of a quarter, then the two-step procedure described above is straightforward. For other maturities, however, we need to make a small adjustment for the stub period. We do this by simple interpolation. To illustrate, consider a 13-month swap and let today be time t = 0. The swap has five cash flows at times $t = 1, 4, 7, 10, 13$ months. At each of these times, we pay the average Treasury bill rate over the prior three months, X_t, where X_t is the average Treasury bill rate from time $t - 3$ months to time t. In exchange, we receive a fixed spread, say s_{13m}. Next, consider a 12-month and a 15-month swap. In a 12-month swap, we make four payments X_t at times $t = 3, 6, 9, 12$ months and receive four fixed cash flows s_{12m}. In a 15-month swap, we make five payments X_t at times $t = 3, 6, 9, 12, 15$ months and receive five fixed cash flows s_{15m}. Neither the 12-month nor the 15-month swap has time $t = 0$ cash flows.

Now, 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 and receive the spread $\tilde{s}_{12m}$. This swap has five cash flows at times $t = 0, 3, 6, 9, 12$ months. Thus, the 13-month swap is a five-payment swap with the first cash flows at time $t = 1$ month. The 15-month swap is a five-payment swap with the first cash flow at time $t = 3$ months and the modified 12-month swap is a five-payment swap with first cash flow at time $t = 0$. In order to find s_{13m}, we simply interpolate between s_{15m} and $\tilde{s}_{12m}$.

The spread $\tilde{s}_{12m}$ is easy to determine simply by setting the present values of cash flows from the 12-month and modified 12-month swaps equal to each other. The spread $\tilde{s}_{12m}$ is

$$\tilde{s}_{12m} = \frac{L(0) - T(0) + s_{12m}\left(D(3) + D(6) + D(9) + D(12)\right)}{1 + D(3) + D(6) + D(9) + D(12)}$$

where $D(t)$ denotes the discount factor for times $t = 3, 6, 9, 12$ months. The stub adjustments for other swap tenors are analogous.

To compare the yield to maturity of the swapped fixed-coupon FRN to the yield of a matched-maturity Treasury note, we convert the quarterly fixed cash flows from the swapped FRN to semi-annual cash flows with dates that precisely match those of the Treasury note. The swapped FRN yield minus the Treasury note yield is the measure of the yield premium.

We also compare Treasury note prices to the prices of the swapped FRNs. For price comparisons, however, we account for differences in coupon rates of the matched-maturity pairs by entering into positions in Treasury STRIPS. The difference between the price on the swapped two-year FRN note and the price on the matched-coupon/matched-maturity two-year Treasury note (swapped FRN minus the Treasury note price) is the measure of the price premium.

A.4.2 A Specific Example

To illustrate how an FRN can be swapped into a synthetic fixed rate bonds, consider an investor who purchases the first FRN (Cusip 912828WK2) on February 3, 2014. This two-year FRN was issued on January 31, 2014 with maturity of January 31, 2016 and fixed spread of $S = 4.563$ basis points (expressed using the actual/actual daycount convention). The quarterly floating rate cash flows are on 4/30/2014, 7/31/2014, 10/31/2014, 1/31/2015, 4/30/2015, 7/31/2015, 10/31/2015, and 1/31/2016. On February 3, 2014, the market price of the FRN is $P = 100.004$ and accrued interest is 0.001111196.

On February 3, 2014, the spread on a Treasury bill basis swap to swap quarterly floating Treasury bill cash flows into three-month Libor cash flows is $F_B = 25.970$ basis points. Since Treasury bill basis swaps pay cash flows calculated from the secondary market 13-week T-bill rate and Treasury FRN pay cash flows calculated from the auction high yield of the most recently issued 13-week T-bill, we adjust the market swap rate by the average difference between the secondary market and auction high yields during the period from 2009 to January 2014 of 0.226 basis points. We note, however, that this adjustment is very robust to the choice of estimation window. Thus, the spread on the Treasury bill basis swap is 26.196 basis points.

On February 3, 2014, the fixed rate on a two-year Libor interest rate with quarterly cash flows that matches the maturity of the FRN is $F_L = 43.260$ basis points. By entering into both swaps, we swap the quarterly floating rate cash flows from the Treasury FRN into fixed cash flows at a fixed rate of $F = 17.064$ basis points. As a result, the investor receives a quarterly net cash flow of $S + F = 17.064 + 4.563 = 21.63$ cents per \$100 notional. Since Treasury FRNs pay quarterly cash flows and Treasury Notes have semiannual cash flows, we re-annuitize the quarterly coupon cash flows to semiannual coupon cash flows. The equivalent semiannual coupon rate is 21.793 basis points. Since, the swapped floating rate note is equivalent to a semiannual fixed rate bond, we can calculate its yield to maturity of 21.591 basis points using standard methods.

On February 3, 2014, the matched-maturity two-year 0.375 percent Treasury note (Cusip 912828B41) has a price of 100.15625 with accrued interest of 0.0031077. It has a yield to maturity of 29.626 basis points. The yield difference between the swapped FRN and the matched-maturity Treasury note is 8.035 basis points which implies that the FRN trades at a premium relative to the Treasury note.

We also calculate the price premium. To make a direct comparison between the swapped FRN and the matched-maturity Treasury note, we adjust for the difference in coupon rates. This is straightforward because there is a large and liquid market in Treasury STRIPS. For each coupon payment date, we simply buy a small notional amount of Treasury STRIPS to make the coupon cash flows exactly equal. On February 3, 2014 the investor pays 31.32 cents for this adjustment. The swapped FRN that exactly matches the cash flows of the matched-maturity Treasury note has a (full) market price of 100.31896. The price the investor pays for the matched-maturity Treasury note is 100.15936. Hence, the price premium the investor pays for the Treasury FRN is 16.09 cents.

A.5 Robustness to Swap Mispricing

To test whether the estimated FRN premia might be driven by the basis swap and/or interest rate swap data that we use in swapping the floating FRN cash flows into fixed, we apply our methodology to two alternative classes of floating rate notes—pairs of floating/fixed rate corporate notes and Federal Farm Credit Bank (FFCB) securities. 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.

First, the floating rate cash flows on corporate FRNs are based on 3-month Libor rates. We apply the same interest rate swaps to swap these notes into fixed rate bonds. Analogous to how we compute FRN premia, we then compare the yields of the swapped notes to those of matched-maturity fixed rate notes from the same firm. Finding no evidence of statistically significant premia would suggest that the standard Libor interest rate swaps we use in our main analysis are fairly priced.

Second, the floating rate cash flows on FFCB notes are indexed to 13-week Treasury bills. Analogous to how we swap Treasury FRNs into fixed rate debt, we first enter into a Treasury bill basis swap and then swap the floating Libor leg from the basis swap into fixed using plain-vanilla interest rate swaps. In doing so, we use not only the same basis and interest rate swap prices as in the main text, 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.

Our 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 identified 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.

Our data on Federal Farm Credit 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 A5 shows summary statistics of the yield differences for the corporate floating/fixed rate note pairs and for the FFCB floating/fixed rate pairs. As shown, the average yield differences between the swapped two-year U.S. corporate bonds and the matched-maturity fixed rate bonds of the same firm taken over all 38 floating/fixed rate corporate bond pairs, is -0.13 basis points which is not statistically significant. In addition, the median yield difference is only -0.06 basis points. Furthermore, the yield differences are nearly evenly divided between positive and negative values; 50.35 percent of the yield differences are positive. Thus, when we use the same plain-vanilla Libor interest rate swap data that we use in estimating the stability premium in Treasury FRNs, we find no significant differences between swapped floating rate and fixed rate corporate debt.

Next, turning to the FFCB results, Table A5 shows that the average difference in yields across all pairs is small. In fact the average difference of -3.08 basis points has the opposite sign to the averages for the FRNs. This provides additional evidence that the estimated premia for FRNs are not simply artifacts of the mispricing of the swaps. It is important to reemphasize that we use not only the same basis and interest rate swap prices as in the main text and apply them to FFCB notes, 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 suggests that the Treasury bill basis swaps and Libor interest rate swaps that we use in our main analysis are fairly priced. The lack of statistically significant premia in corporate floating rate debt and FFCB notes, provides additional evidence that the estimated premia for Treasury FRNs are not simply artifacts of the mispricing of the swaps.

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 Eikon.
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 Rate 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 Thomson/Reuters Eikon.
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.treasurydirect.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	Repo Rates	Daily	General collateral overnight, and one-week, two-week, three-weeks, one month to three month term repo rates from the Bloomberg system.
7	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.
8	Discount Function	Daily	Discount function out to two years calculated from GC repo rates and U.S. Treasury Strips data as described in Liu, Longstaff, Mandell (2006).
9	Treasury Bill Basis Swap Spreads	Daily	Thirteen-week US Treasury bill yield into three-month Libor basis swap spreads. Spreads on US Treasury basis swaps with quarterly cash flows are quoted on the Bloomberg system for tenors of 3, 6, 9, 12, 18, and 24 months.
10	Libor Interest Rate Swap Spreads	Daily	Three-month Libor into fixed interest rate swap rates. Cash flows on the fixed leg are semi-annual, and the floating leg pays three-month Libor each quarter.
11	Thirteen-week Treasury Bill Yields	Daily	Discount yields of the on-the-run 13-week U.S. Treasury bill.

Table A1 - Continued

	Data	Frequency	Description and Source
12	Treasury CMT Rate	Daily	One-year constant maturity Treasury rate from Federal Reserve H.15 Selected Interest Rates Release.
13	OIS Spread	Daily	The spread between three-month Libor and the three-month U.S. Overnight Indexed Swap (OIS) rate.
14	Libor	Daily	The 3-month London Interbank Offered rate from the Bloomberg system.
15	VIX	Daily	The CBOE Volatility Index of option-implied volatilties from S&P 500 index options, obtained from the Bloomberg system.
16	Treasury Volatility	Daily	The Merrill Lynch MOVE index of implied basis point volatilities on one-month Treasury options from the Bloomberg system.
17	Inflation	Monthly	The U.S. non-seasonally-adjusted Consumer Price Index of All Urban Consumers (CPI-U) published by the U.S. Bureau of Labor Statistics.
18	Inflation Volatility	Daily	Implied basis point volatility for a two-year inflation option straddle with exercise price equal to two percent. The straddle is a long position in a zero-coupon inflation cap and inflation floor with two-year maturity and strike price equal to two percent. Data obtained from the Bloomberg system.
19	Precious Metals Index	Daily	The return on the UBS Bloomberg CMCI Precious Metals constant maturity total return index of gold, silver, and platinum futures contracts obtained from the Bloomberg system.
20	Dollar Index	Daily	The ICE index of the value of the U.S. dollar against a basket of major world currencies obtained from the Bloomberg system.
21	Money Market Flows	Biweekly	Total net assets and fund flows of U.S. Government (USS) and U.S. Treasury Money Market Funds (UST) from Thomson/Reuters Eikon. These funds invest 99.5% of total assets in cash, U.S. government securities and/or repurchase agreements that are collateralized solely by government securities or cash with a weighted average maturity of sixty days or less, and keep constant net asset value. Data include closed- and open-end funds and ETFs.
22	Treasury CDS	Daily	The two-year sovereign credit default swap spread on U.S. Treasury debt from the Bloomberg system.
23	Dealer CDS	Daily	The five-year credit default spread on primary dealers to the New York Fed. The list of primary dealers is available at https://www.newyorkfed.org/markets/primarydealers.
24	Floating Rate Corporate Bonds	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 maturity at issue, no embedded options, and pay off par at maturity.
25	FFCB Bonds	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, have no embedded options, and pay off par at maturity.

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 F for three-month Libor 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	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 Treasury Bill Interest Rate Swaps. This table presents summary statistics for swap rates from taking a position in a Treasury bill basis swap and simultaneously executing a standard 3-month Libor interest rate swap with the same maturity. The combined swap is a floating-for-fixed swap that converts quarterly floating cash flows from the Treasury FRN into semi-annual fixed cash flows over the life of the swap. The rate on the floating leg is the 13-week Treasury bill index rate. The table shows summary statistics for the rate on fixed leg denoted by F. The spread F is annualized and measured in basis points. The columns titled Mean, Median, Min, and Max show the average, median, smallest, and largest rates F over the sample period. The column titled Std Dev shows the sample standard deviation of the fixed swap rate. The column titled Months to Maturity lists the tenors of the swap contracts in months and 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	43.74	47.47	0.71	25.87	165.28	1,085
6	47.84	50.16	1.33	29.34	173.50	1,085
9	52.71	51.51	0.44	33.57	182.82	1,085
12	57.49	52.12	3.39	35.99	189.60	1,085
15	62.57	51.84	4.94	40.08	197.97	1,085
18	68.01	51.24	7.63	44.77	205.68	1,085
21	73.52	50.35	11.98	51.33	211.27	1,085
24	79.09	49.32	17.24	57.22	216.14	1,085

Table A4

Example of the Cash Flows from Swapping a Floating Rate Note into Fixed. This table illustrates the cash flows from swapping a two-year FRN into fixed. P denotes the current market price of a two-year FRN, X_t denotes the floating 13-week Treasury bill index rate, and S denotes the fixed spread on the FRN. F denotes the market-determined fixed rate on the interest rate swap. The column titled Timing Of The Cash Flow shows the time at which cash flows on the FRN are paid or received. The column titled FRN Cash Flow shows the cash flows paid by a FRN. The column titled Swap Cash Flows shows the cash flows from a swap in which the investor pays quarterly floating rate cash flows and received quarterly fixed cash flows. The column titled Net Cash Flow shows the sum of the FRN cash flows and the swap cash flows.

Timing Of The Cash Flow	FRN Cash Flow	Swap Cash Flow	Net Cash Flow
0.00	$-P$	0	$-P$
0.25	$X_{0.25} + S$	$F - X_{0.25}$	$F + S$
0.50	$X_{0.50} + S$	$F - X_{0.50}$	$F + S$
0.75	$X_{0.75} + S$	$F - X_{0.75}$	$F + S$
1.00	$X_{1.00} + S$	$F - X_{1.00}$	$F + S$
1.25	$X_{1.25} + S$	$F - X_{1.25}$	$F + S$
1.50	$X_{1.50} + S$	$F - X_{1.50}$	$F + S$
1.75	$X_{1.75} + S$	$F - X_{1.75}$	$F + S$
2.00	$X_{2.00} + S + 100$	$F - X_{2.00}$	$F + S + 100$

Table A5

Summary Statistics for the Corporate and Federal Farm Credit Bank Bond Premia. The first row labeled Corporate presents summary statistics for the average premia in corporate floating rate notes measured relative to fixed rate notes of the same firm. The premia are computed as the difference between the yield on the fixed rate note and the yield on the swapped corporate floating rate note. Yield differences are measured in basis points. A positive yield difference implies that the yield on the corporate fixed rate note is higher than the yield on the swapped floating rate note. The second row labeled FFCB presents summary statistics for the average premia in Federal Farm Credit Bank (FFCB) notes measured relative to FFCB fixed rate notes. The premia are computed as the difference between the yield on the fixed rate FFCB note and the yield on the swapped floating rate FFCB note. Yield differences are measured in basis points. A positive yield difference implies that the yield on the fixed rate FFCB note is higher than the yield on the swapped floating rate FFCB note. Std Dev denotes the standard deviation. N denotes the number of observations. The sample period is daily from January 31, 2014 to March 29, 2018.

	Number of Pairs	Mean	Std Dev	Min	Median	Max	Percent Positive	N
Corporate	38	−0.13	9.14	−22.19	−0.06	21.41	50.35	6,637
FFCB	32	−3.08	25.64	−129.04	−9.05	71.44	39.64	4,659