Demystifying the US Treasury Floating Rate Note Puzzle: A Swap Market Perspective

Jungkyu Ahn[a] and Yongkil Ahn[b,*]

Abstract

We compare two versions of the US Treasury floating rate note (FRN) price measured in Treasury auctions and in the swap market. Utilizing a proprietary dataset from J.P. Morgan, we find that the actual US Treasury FRNs are traded in premium in comparison with their synthetic equivalents in the swap market, and the premium amounts to four basis points on average. Moreover, they are priced up by four more basis points when the aggregate fixed income market is in turmoil, confirming that US Treasury FRNs are indeed safe assets, and thus require a price premium ex ante.

JEL Classification: G12

Keywords: Floating rate note, Safe asset, Discount margin, Asset swap, Basis swap

Declarations of interests: None.

[a] Monash University, Australia
[b] Seoul National University of Science and Technology, Republic of Korea
* Corresponding author. Mailing address:232 Gongneung-ro, Nowon-gu, Seoul 01811, Republic of Korea. Email: yongkil.ahn@seoultech.ac.kr. Telephone: +82-2-970-7176.

Highlights

- This study compares two versions of the US Treasury Floating Rate Note (FRN) price.
- We utilize a novel proprietary swap market data from J.P. Morgan.
- We replicate actual FRNs using over-the-counter swap contracts.
- Actual FRNs are priced in premium compared with their swap-market equivalents.
- Actual US Treasury FRN prices are increasing in fixed income market uncertainty.

1. Introduction

The real financial market features frictions such as capital adjustment costs (Bloom, 2009), financing and investment hurdles (Kuehn and Schmid, 2014), credit constraints (Miao and Wang, 2018), liquidity risk (Brunnermeier and Pedersen, 2009), and so on. These factors are intuitive, but accounting for the causal link to asset prices has proven far from simple. This study demystifies the US Treasury FRN premium and investigates how idiosyncratic uncertainty shocks and the demand for safe assets affect investors' dynamic optimal decisions and, thus, asset prices in the fixed income market.

US government securities are one of the most pronounced fixed income and interest rate instruments in the financial market (Chordia et al., 2005; Goyenko and Ukhov, 2009). While nominal Treasuries (such as bills, notes, and bonds) account for most of the total notional outstanding of government debts, other types of securities with the same full faith and creditworthiness of the US government are also available. For instance, Treasury Inflation-Protected Securities (TIPS) were introduced in 1997, and Floating Rate Notes (FRNs) were launched in 2014. A large premium or discount appears in the cross-section of the US Treasury securities markets (Longstaff, 2004). For example, on-the-run nominal treasuries are generally more expensive and liquid than otherwise identical off-the-run issues (Amihud and Mendelson, 1991; Kamara, 1994; Krishnamurthy, 2002). In the TIPS market, inflation linkers trade at a significant discount relative to nominal Treasuries (Fleckenstein et al., 2014). In the FRN market, floaters are overvalued in comparison with nominal Treasuries (Fleckenstein and Longstaff, 2020).

We focus on the FRN market with the following three motivations. First, the empirical literature on FRNs is scant. A study demonstrating the risk and return of FRNs in an early market finds that FRNs provide a positive excess return over indexed rates (Bhanot and Guo, 2017). FRNs are priced at discounts, as they pay additional interest that surpasses the referenced Treasury bill rates (Hartley and Jermann, 2020). On the other hand, another literature strand documents that FRN prices incorporate significant price premia in a proper comparison with Treasury bills and notes, which has been dubbed as the US Treasury floating rate note puzzle. The literature attributes this wedge to, for example, convenience yields for the marking-to-market advantage from the stability of FRN prices (Fleckenstein and Longstaff, 2020). We intend to ease this tension in the literature and provide new insights regarding the price dynamics of Treasury FRNs. Second, the nature of FRN prices particularly attracts investors who demand low volatility during periods of recent rate hikes. Given that US Treasury FRNs pay variable coupons indexed to the 13-week Treasury bill rates, FRN prices hover around at par. In this regard, FRNs offer alternative investment options for investors with low volatility, such as money market funds, encouraging them to participate in the FRN market when interest rates increase. It is a timely moment to improve our understanding of empirical phenomena in the FRN market when confronted with high inflation and policy steps. Third, we offer another perspective that not only linearly replicates FRNs but also dramatically eases the practical implementation of arbitrage trades. Our angle takes root in the asset swap market, which is much simpler than the traditional strategies that necessarily rely on a number of customized zero-coupon bonds.

In this paper, we take advantage of a novel proprietary dataset from J.P. Morgan and quantify the magnitude of the US Treasury FRN premium through an angle of the over-the-counter (OTC) swap market. The key concept in our new approach is asset swap spreads. We construct two implied quoted spreads that force FRN prices at par: one from synthetic FRNs replicated through the swap market and the other from the observed discount margins of actual FRNs in the cash bond market. We then compare whether the two measures deviate from each other. It appears that actual US Treasury FRNs are traded in premium, and the premium amounts to four basis points on average. We further investigate the spread/margin sensitivity of a market-wide uncertainty metric in the fixed income market. When the fixed income market uncertainty is high, market participants shift into actual FRNs, confirming that US Treasury FRNs are indeed safe assets, and thus require a price premium ex ante.

2. Replicating FRNs: A swap-based approach

Following the inception of the interest rate swap (IRS) market in the 1980s, the asset swap markets began in the early 1990s. An asset swap combined with the purchase of a cash bond translates any fixed cash flows from the entitled bond into a variable cash flow stream, creating a synthetic floater and consequently reducing the effective duration of the reference bond held.[1] Asset swaps are of great relevance to the intrinsic role of financial intermediaries, enabling banks to manage the mismatch between their short-term liabilities (i.e., deposits) and long-term assets (i.e., bonds and loans). Thus, financial institutions continue to use asset swaps. Inspired by the popularity of asset swaps in the fixed-income market, we adopt a simple yet intuitive approach using popular OTC swap contracts.[2]

Our new replication strategy consists of two building blocks:1) asset swaps and 2) basis swaps. First, asset swaps serve as a foundation for creating synthetic floaters based on London Inter-Bank Offered Rates (LIBORs). An asset swap is a tailored IRS whose fixed leg instead pays cash flows emanating from a specific bond held rather than a fixed rate in the original IRS. Asset

[1] For a detailed description on asset swaps, see, for example, Duffie (1999) and Aussenegg, Götz, and Jelic (2016).
[2] OTC markets do not provide precise figures on volume, bid-ask spreads, or size. However, industry white papers and other sources (such as the International Swap and Derivatives Association or British Bankers' Association) reveal that those instruments on US government securities are liquid enough.

swaps convert fixed cash flows from a reference bond into variable cash flows. As such, an asset swap is a customized interest rate swap (IRS) whose fixed leg pays cash flows emanating from a specific bond rather than the fixed rate in the original IRS. As shown in Table 1 below, a par asset swap on a Treasury Note renders the note to be a LIBOR-based floater. Second, basis swaps exchange two floating rates, settling the gap in reference rates between asset-swapped nominal Treasuries and Treasury-bill-based FRNs. As basis swaps change the LIBOR-based variable cash flows of the asset-swapped note into Treasury bill-based variable cash flows, we obtain a Treasury bill-based replicator equating an actual FRN. These steps imply that asset swap spreads (A in Table 1) and basis swap spreads (B in Table 1) form the implied quoted spreads of the replicated FRNs via the swap market - first, the replicated FRNs are priced at par owing to the par asset swaps used, and second, those replicated synthetic FRNs pay X+A+B where floaters are indexed to T-Bill rates referring to X in Table 1

We continue to discuss the detailed pricing mechanism of Treasury FRNs in relation to their quoted spreads in the primary and secondary markets. US Treasury FRNs pay quoted spreads on top of the 13-week Treasury bill rates. In a regular Treasury auction, the quoted spread on a floater is set as the highest accepted discount margin in that auction.[3] Given that FRNs are issued at par, the process of the Treasury auction implies that bidders' desired discount margins represent the expected quoted spread of a floater in addition to its reference rates. Discount margins are also established in the secondary market, as they are the margins over the reference curve that equate the present value of a floater's assumed cash flows to the current market price. We adopt the observed discount margins on a chain of on-the-run FRNs in the market. Once we

[3] For more details, see Title 31, the Code of Federal Regulations, Part 356 - Sale and Issue of Marketable Book-Entry Treasury Bills, Notes, and Bonds, Appendix B, Section IV. Formulas for the Conversion of Floating Rate Note Discount Margins to Equivalent Prices.

set the quoted spreads as equivalent to the discount margins in the secondary market, the discount margins best describe the market-based quoted spreads that might be offered in an imaginary auction today. Hence, should we have a daily auction in place, the floater would be priced at par with the quoted spread equivalent to the observed discount margin.

Table 1: Replication Strategy via the Swap Market

P is the market price of the two-year on-the-run T-Note. *C* is the fixed coupons of the T-Note whose face value is 100. *A* refers to asset swap spreads. *X* represents the average of the three-month T-Bill rate, as Treasury floaters are indexed to the most recent 13-week (weekly) Treasury bill auction rate. *B* denotes Treasury basis swap spreads, where the Treasury leg is identical to the FRN index. *DM* refers to the discount margin of on-the-run FRNs. All instruments use the actual/360 money market convention. *A, B, and DM* are in the form of per annum spreads.

Timing	T-Note (buy)	Par Asset Swap (Pay Fixed)	Par Asset Swap (Receive Floating)	Basis Swap (Pay LIBOR)	Basis Swap (Receive T-Bill)	Replicated FRN	FRN Deemed at Par	Diff In Cash Flows
0	-P	+P	-100			-100	-100	-
0.25			LIBOR+A	-LIBOR	X+B	X+B+A	X+DM	B+A-DM
0.50	C	-C	LIBOR+A	-LIBOR	X+B	X+B+A	X+DM	B+A-DM
0.75			LIBOR+A	-LIBOR	X+B	X+B+A	X+DM	B+A-DM
1.00	C	-C	LIBOR+A	-LIBOR	X+B	X+B+A	X+DM	B+A-DM
1.25			LIBOR+A	-LIBOR	X+B	X+B+A	X+DM	B+A-DM
1.50	C	-C	LIBOR+A	-LIBOR	X+B	X+B+A	X+DM	B+A-DM
1.75			LIBOR+A	-LIBOR	X+B	X+B+A	X+DM	B+A-DM
2.00	C+100	-[C+100]	LIBOR+A +100	-LIBOR	X+B	X+B+A+100	X+DM+100	B+A-DM

In Table 1 above, we construct a synthetic FRN using the T-Note, par asset swap, and basis swap, eventually being priced at par. On the other hand, we consider a hypothetical FRN offering a quoted spread identical to the discount margins observed in the market. Given that we have two Treasury bill-based floaters concurrently priced at par, those two securities provide the same cash flows. After netting both cash flows, the bases (differences in cash flows) amount to 'Asset Swap Spreads + Basis Swap Spreads – Discount Margins'. FRN premia (discounts) occur when the sum of the asset swap spreads and basis swap spreads is greater (less) than the implied quoted spreads proxied by observed discount margins. FRN price premia indicate that investors tilt toward an actual par FRN that pays ‘X+DM’ even though the equivalent FRNs replicated using asset and basis swaps offer ‘X+B+A’, which dominates ‘X+DM’ from the actual FRNs.

We reiterate that our new replication strategy has advantages over Fleckenstein and Longstaff (2020). The replication strategy in Fleckenstein and Longstaff (2020) comprises three major steps in obtaining the price of a replicated FRN with identical cash flows to an actual on-the-run FRN : 1) buy a Treasury Note and enter into an IRS to exchange fixed coupon streams of the bond with LIBOR-based floating cash flows, 2) initiate a basis swap to obtain the weekly averages of the 13-week T-bill rates against LIBOR, and 3) use Separate Trading of Registered Interest and Principal of Securities (STRIPS) to adjust mismatched cash flows, such as gaps between the bond coupons and the IRS fixed rate, including the quoted spread in the on-the-run FRN’s issuing terms. Our approach, which mirrors the cash flows of a floater via the swap market, is a tractable way to replicate a synthetic FRN with constant maturity because ours does not call for trading a basket of miscellaneous STRIPS securities. It should be noted that our notion of whether FRNs are at premia or discounts concurs with the literature. In Fleckenstein and Longstaff (2020), FRN premia refer to the situation in which on-the-run FRNs are expensive, compared with their replicators mimicking identical cash flows. The difference is that we compare the cash flows (specifically, two implied quoted spreads) of two FRNs at the same price, instead of the prices of FRNs with identical cash flows.

3. Data and results

The data are provided by J.P. Morgan. Swaps build on OTC markets. We obtain matched-maturity asset swap spreads on two-year on-the-run Treasury notes and Treasury basis swap spreads against LIBOR. We also acquire discount margins on two-year on-the-run FRNs. The raw data are daily observations from 2014 (the year when the US FRN was first issued) to 2020. We aggregate the data over each week to minimize the impact of microstructural noises in the US treasury market. Table 2 summarizes our key metrics.

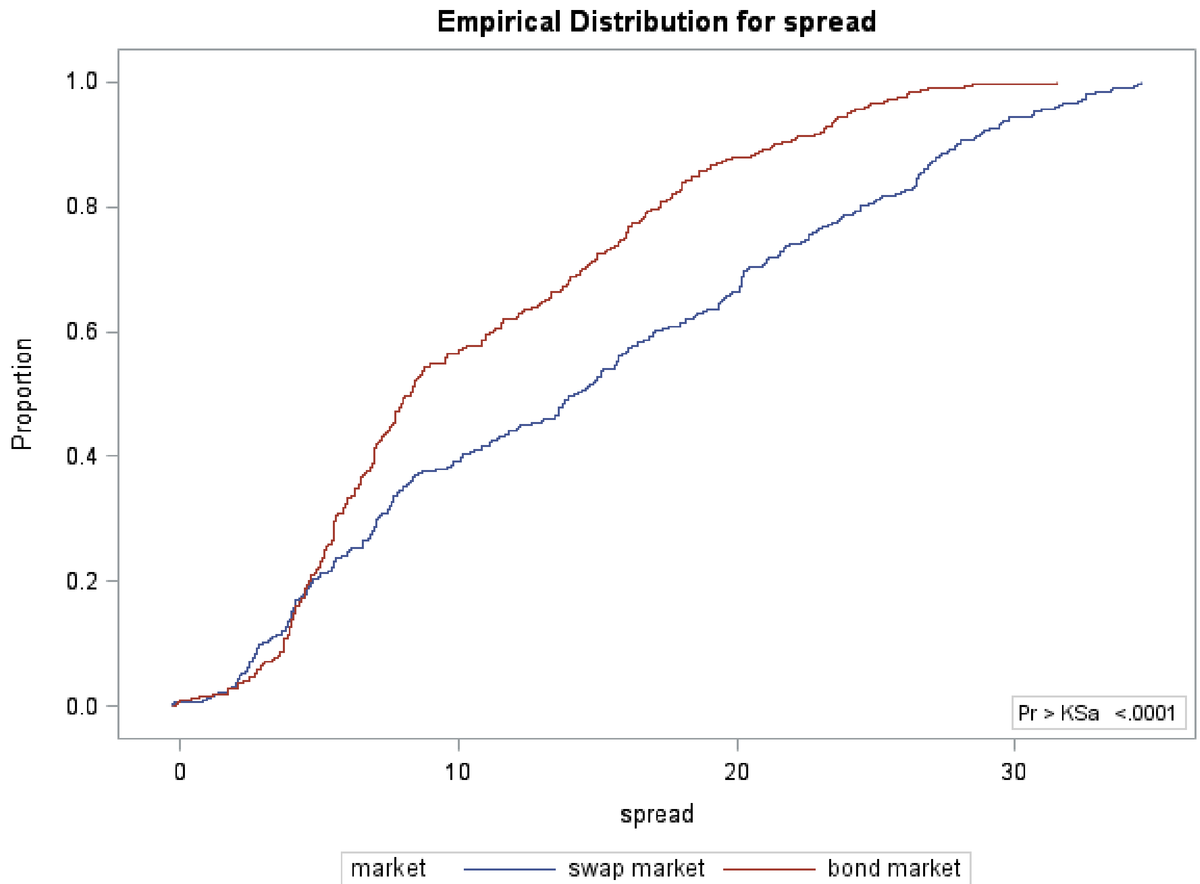
Table 2: Summary Statistics

Data are weekly. Numbers are in basis points. N is the number of observations. Std. Dev. refers to the standard deviation.

Variable	N	Mean	Std. Dev.	Min	P25	Median	P75	Max
Asset swap spread (A)	349	-16.49	8.52	-35.82	-23.68	-17.82	-8.88	1.42
Basis swap spread (B)	349	31.25	7.89	11.05	27.00	30.03	34.46	52.88
Discount margin (D)	349	10.72	6.89	-0.16	5.25	8.25	15.95	31.50
FRN premium (A+B-D)	349	4.03	6.03	-11.28	-0.91	4.40	8.59	20.94

Because the focus of this study is on whether discount margins in the FRN market are indeed less than their equivalent spreads in the swap market, we conduct a two-sample Kolmogorov-Smirnov test. In Figure 1, we quantify a distance between the empirical cumulative distribution functions of synthetic FRN spreads (i.e., asset swap spreads plus basis swap spreads) and actual FRN spreads (i.e., discount margins). The Kolmogorov-Smirnov test statistic is 0.2349, with a p-value of 0.0000. Thus, swap spreads in the derivatives market (the blue line in Figure 1) are statistically significantly bigger than discount margins in the cash bond market (the red line in Figure 1), confirming the US Treasury FRN puzzle.

Figure 1: Kolmogorov-Smirnov Test (Asset + Basis Swaps vs. Discount Margin)



To better understand the origins of this stylized empirical fact in the fixed income market, we explore the spread/margin sensitivity of a market-wide uncertainty metric, as in Bloom (2009). We utilize the Chicago Board Options Exchange's Interest Rate Swap Volatility Index (SRVIX). As the VIX index is a measure of expected volatility in the US equity market, SRVIX (the expected volatility of forward ten-year swap rates) is a measure of expected volatility in the US fixed income market. We consider an indicator that captures those weeks when the changes in SRVIX spike up significantly above the mean. The fixed income market volatility indicator takes a value 1 for 17 weeks among 349 observation weeks in the sample, and 0 for the other weeks. These 17 weeks are explicitly chosen at the 5% one-tailed significance level, treating each week as an independent observation.[4] We proceed to check the swap spread/discount margin sensitivity of the SRVIX spike indicator function using the following regression:

$$\boldsymbol{Y}_t = \mathbf{I}_t\beta + \boldsymbol{C}_t\gamma + \varepsilon_t \quad (1)$$

where time (t) is daily; $\boldsymbol{Y}$ is a column vector whose elements are the swap spread or discount margin; **I** is an explanatory variable vector that denotes the fixed income market volatility spike indicator; **C** is a control variable matrix that includes the three-month treasury bill rate and FRN's outstanding amount (i.e., "size" in the stock market); and ε is a white noise vector. Because the number of observations is 348 and the data are weekly, we compute Newey-West standard errors with a maximum of four lags.

Table 3: The Spread Sensitivity of SRVIX

Time is weekly. N denotes the number of observations. Newey-West-robust test statistics with four lags are reported in square brackets. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively. SRVIX is obtained from the Chicago Board of Options Exchange.

	Dependent variable	
	Swap spreads	Discount margins
I_{SRVIX}	4.3138* [1.81]	2.6384 [1.11]
N	348	348
F statistic	10.37***	5.10***

Table 3 reports the results. The coefficient for swap spreads is 4.3138, implying that when the US fixed income market becomes very volatile, synthetic FRNs are priced down by 4.3138 basis points. This price drop is not observed for actual FRNs because the coefficient for discount margins is not significantly different from zero. Put differently, the actual US Treasury FRNs are

[4] The threshold is 1.65 standard deviations. The total number of observations is 348, and we select 17 weeks. Note that 17/349=0.0487.

priced up by approximately four basis points when the aggregate fixed income market is in turmoil. These findings posit that actual FRNs are safe assets when the fixed income market uncertainty is high (Asgharian, Christiansen, and Hou, 2015; He, Krishnamurthy, and Milbradt, 2019).

4. Conclusion

Because US Treasury securities are near-money, market participants incorporate a substantial premium into the prices of US Treasury bills, notes, and bonds. The near-money characteristic of US Treasury securities makes it possible to be easily converted to cash during flight-to-quality episodes (Papadamou, Fassas, Kenourgios, and Dimitriou, 2021). As a result, US Treasury securities tend to include a large price premium. Using swap market data, we quantify the magnitude of this price premium and show that the premium is as much as four basis points per annum on average. Also, it turns out that US Treasury FRNs are indeed safe assets. The observed discount margins are not responsive to extreme SRVIX events, which is in sharp contrast to other assets, for example, cryptocurrencies (Ahn, 2022; Conlon and McGee, 2020).

The US Treasury securities market is one of the largest and most liquid fixed income markets in the world, with a total outstanding notional amount equal to $25.86 trillion as of December 2021.[5] In this study, we document deviations from the equilibrium asset pricing conditions in the US Treasury FRN market and quantify the time variation of such deviations upon fixed income market uncertainty shocks. Contrary to the conventional view, the deviations for US Treasury FRNs do not vanish over time in Treasury auctions. They are particularly strong when there is an uncertainty shock in the fixed income market. Given that these deviations persist in one of

[5] https://www.bis.org/statistics/secstats.htm

the largest and most liquid fixed income markets in the world, other arbitrage opportunities may exist (Garleanu and Pedersen, 2011; Bai and Collin-Dufresne, 2019). Hence, looking beyond this study, further investigating whether other deviations in the US Treasury market exist and what factors drive the deviations in detail, similar to Du et al. (2018) and Shehadeh et al. (2021), might be an interesting avenue for future research.

References

Ahn, Y. (2022). Asymmetric tail dependence in cryptocurrency markets: A Model-free approach. *Finance Research Letters*, *47*, 102746.

Amihud, Y., & Mendelson, H. (1991). Liquidity, maturity, and the yields on US Treasury securities. The Journal of Finance, 46(4), 1411-1425.

Asgharian, H., Christiansen, C., & Hou, A. J. (2015). Effects of macroeconomic uncertainty on the stock and bond markets. Finance Research Letters, 13, 10-16.

Aussenegg, W., Götz, L., & Jelic, R. (2016). European asset swap spreads and the credit crisis. *The European Journal of Finance*, *22*(7), 572-600.

Bai, J., & Collin-Dufresne, P. (2019). The CDS-bond basis. *Financial Management*, *48*(2), 417-439.

Bhanot, K., & Guo, L. (2017). The new market for treasury floating rate notes. The Journal of Fixed Income, 27(2), 52-64.

Bloom, N. (2009). The impact of uncertainty shocks. Econometrica, 77(3), 623-685.

Brunnermeier, M. K., & Pedersen, L. H. (2009). Market liquidity and funding liquidity. *The Review of Financial Studies*, *22*(6), 2201-2238.

Chordia, T., Sarkar, A., & Subrahmanyam, A. (2005). An empirical analysis of stock and bond market liquidity. *The Review of Financial Studies*, *18*(1), 85-129.

Conlon, T., & McGee, R. (2020). Safe haven or risky hazard? Bitcoin during the COVID-19 bear market. Finance Research Letters, 35, 101607.

Du, W., Tepper, A., & Verdelhan, A. (2018). Deviations from covered interest rate parity. *The Journal of Finance*, *73*(3), 915-957.

Duffie, D. (1999). Credit swap valuation. *Financial Analysts Journal*, *55*(1), 73-87.

Fleckenstein, M., & Longstaff, F. A. (2020). The US Treasury floating rate note puzzle: Is there a premium for mark-to-market stability? Journal of Financial Economics, 137(3), 637-658.

Fleckenstein, M., Longstaff, F. A., & Lustig, H. (2014). The TIPS-treasury bond puzzle. the Journal of Finance, 69(5), 2151-2197.

Garleanu, N., & Pedersen, L. H. (2011). Margin-based asset pricing and deviations from the law of one price. *The Review of Financial Studies*, *24*(6), 1980-2022.

Goyenko, R. Y., & Ukhov, A. D. (2009). Stock and bond market liquidity: A long-run empirical analysis. *Journal of Financial and Quantitative Analysis*, *44*(1), 189-212.

Hartley, J. S., & Jermann, U. (2020). Should the US Government Issue Floating Rate Notes? (No. w27065). National Bureau of Economic Research.

He, Z., Krishnamurthy, A., & Milbradt, K. (2019). A model of safe asset determination. American Economic Review, 109(4), 1230-62.

Kamara, A. (1994). Liquidity, taxes, and short-term treasury yields. Journal of Financial and Quantitative Analysis, 29(3), 403-417.

Krishnamurthy, A. (2002). The bond/old-bond spread. *Journal of financial Economics*, *66*(2-3), 463-506.

Kuehn, L. A., & Schmid, L. (2014). Investment-based corporate bond pricing. *The Journal of Finance*, *69*(6), 2741-2776.

Longstaff, F. A. (2004). The Flight-to-Liquidity Premium in US Treasury Bond Prices. *The Journal of Business*, *77*(3), 511-526.

Miao, J., & Wang, P. (2018). Asset bubbles and credit constraints. *American Economic Review*, *108*(9), 2590-2628.

Papadamou, S., Fassas, A. P., Kenourgios, D., & Dimitriou, D. (2021). Flight-to-quality between global stock and bond markets in the COVID era. Finance Research Letters, 38, 101852.

Shehadeh, A. A., Li, Y., Vigne, S. A., Almaharmeh, M. I., & Wang, Y. (2021). The existence and severity of the forward premium puzzle during tranquil and turbulent periods: Developed versus developing country currencies. *International Review of Financial Analysis*, *78*, 101871.