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The SOFR discount☆

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ABSTRACT

The transition from London Interbank Offered Rate (LIBOR) to Secured Overnight Financing Rate (SOFR) affects the reference rate of floating-rate debt worth trillions of dollars. We provide the first evidence highlighting a *benefit* of the benchmark transition for debt markets. Focusing on the market for dollar-denominated floating rate notes (FRNs), we compare the yield spreads of FRNs linked to LIBOR and SOFR, issued by the same entity during the same month. After adjusting for the maturity-matched spreads from derivatives markets, we find significantly *lower* spreads for SOFR-linked FRNs. We link this *SOFR discount* to the enhanced price stability of SOFR-linked FRNs.

0. Introduction

The transition from London Interbank Offered Rate (LIBOR) to Secured Overnight Financing Rate (SOFR) is one of the most significant events in financial markets to date—it affects the reference rate for loans and other floating rate debt worth trillions of dollars and sparked an ongoing debate between policymakers and market participants. Policymakers support the adoption of SOFR as reference rate because of its resilience to manipulation. However, SOFR captures the cost of funding US Treasuries overnight and is therefore less representative of market-wide funding conditions than LIBOR (e.g., Schrimpf and Sushko, 2019; Klingler and Syrstad, 2021). Consequently, investors in SOFR-linked debt lose the hedging benefit of receiving higher interest payments during funding crises that was inherent in LIBOR (e.g., Jermann, 2019; Cooperman et al., 2022). This loss of hedging benefits is a key concern for market participants: Bank lenders prefer a reference rate sensitive to market-wide funding conditions (Marshall et al., 2019) and major data vendors such as Bloomberg and Markit have been trying to establish such credit-sensitive alternative reference rates. Despite market participants' preference for credit-sensitive rates, regulators kept SOFR as main reference rate (e.g., Gensler, 2021). As most floating-rate debt is now linked to SOFR, this forced benchmark transition raises an important question: Does the LIBOR-SOFR transition affect the cost of borrowing floating-rate debt?

The market for dollar-denominated floating rate notes (FRNs) is an ideal laboratory for answering this question. In the primary market, we observe FRN issuances linked to both LIBOR and SOFR from the same entity during the same month. In addition, we observe secondary market quotes linked to both LIBOR and SOFR at the same trading day. Moreover, the predetermined payment schedule of FRNs allows us to adjust the expected difference in variable rate payments with maturity-matched spreads from derivatives markets. Contrasting with the concerns outlined above, borrowers benefit from a *SOFR discount*, paying *lower* adjusted yield spreads for SOFR-linked FRNs. This SOFR discount is stronger during times of heightened interest rate uncertainty and for FRNs from safer issuers. Hence, the higher price stability of FRNs with payments tied to an overnight rate instead of a term rate is a plausible explanation for the SOFR discount. By contrast, legal concerns about the LIBOR cessation only partially explain our findings, suggesting our results are not unique to the transition period.

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The agency overseeing LIBOR announced in 2017 that the publication of LIBOR cannot be guaranteed beyond 2021 (Bailey, 2017). Following this announcement, SOFR became the preferred alternative reference rate in the US (ARRC, 2017) and issuing LIBOR-linked floating-rate debt is effectively banned since January 2022 (FDIC, 2021). While regulators endorse SOFR because it is based on large transaction volumes and compliant with the principles for financial benchmarks (IOSCO, 2013), market participants criticize that a term rate based on SOFR does not reflect banks' marginal funding costs. SOFR is an overnight rate based on repurchase agreements collateralized with US Treasuries. Hence, reference rates based on SOFR are (i) less sensitive to fluctuations in market-wide funding conditions and (ii) generally lower than LIBOR.

Because of these differences between LIBOR and SOFR, the issuance spreads of SOFR-linked debt are not directly comparable to LIBOR-linked debt. To make the borrowing costs associated with issuing FRNs comparable, we change the variable-rate payments to fixed-rate payments by using interest rate swaps with the same maturity as the FRNs. We illustrate our approach by considering the hypothetical situation in which we observe the issuance of two FRNs from the same borrower. Assume the only difference between the two FRNs is that the reference rate of the first FRN is LIBOR, while the reference rate of the second FRN is SOFR. Adding the fixed rates of an interest rate swap referencing LIBOR to the first FRN and an overnight-index swap (OIS) referencing SOFR to the second FRN should, in theory, result in identical cash flows. Building on this argument, we use interest rate swaps and SOFR OIS to obtain precise spread adjustments. Our analysis then focuses on comparing the adjusted issuance spreads.

In the first and main part of our paper, we quantify the yield differences between LIBOR-linked and SOFR-linked FRNs. We use panel regressions in which the main independent variable is an indicator that equals one if the FRN is SOFR-linked and zero otherwise. Our rich sample allows us to control for issuer-month fixed effects, which absorb unobservable fluctuations in the credit quality of the underlying issuer. In addition, we experiment with using less stringent specifications with rating-month fixed effects. We also examine the role of different controls, such as issuance size and time-to-maturity, all interacted with month fixed effects to capture unobservable fluctuations in the role of the control variables over time. In all specifications, we find significantly lower spreads for SOFR-linked FRNs, with estimates ranging from −6.60 basis points to −4.56 basis points. This SOFR discount is robust to using different specifications (e.g., cross-sectional regressions or matched pairs), different spread adjustments (e.g., based on futures contracts or basis swaps), and different subsamples of our main data.

Based on our estimates, the FRN issuers in our sample saved up to $669 million in interest expenses during the transition period alone. The magnitude of these savings is comparable to the results of Fleckenstein and Longstaff (2020), who estimate the US Treasury safed approximately one billion dollars over a four-year period by issuing FRNs.

We next compare the spreads of LIBOR-linked and SOFR-linked FRNs in the secondary market. Despite only observing price quotes for a small subsample of FRNs, we find a qualitatively similar pattern with SOFR-linked FRNs having lower spreads than LIBOR-linked FRNs. Using these secondary market quotes, we also perform an out-of-sample test and examine the relative pricing of SOFR-linked FRNs in the January 2022 to June 2023 period (not covered in our main analysis) and find a qualitatively similar SOFR discount.

In the second part of the paper, we offer an explanation for the SOFR discount. We show that the prices of SOFR-linked FRNs are significantly less volatile than those of LIBOR-linked FRNs. This lower price volatility is due to the qualitative difference between the two reference rates; SOFR-linked FRNs pay an average overnight rate, calculated over the payment quarter, while LIBOR-linked FRNs pay a term rate that is determined at the beginning of the payment quarter. In addition, the main investors in FRNs are Money Market Mutual Funds (MMFs), which hold 54% of the FRNs in our sample, on average. Because MMFs value assets with higher mark-to-market stability (e.g., Fleckenstein and Longstaff, 2020), it is plausible that the SOFR discount is driven by the additional price stability of SOFR-linked FRNs.

Consistent with this explanation, we show the SOFR discount is more pronounced during periods of elevated interest rate volatility. This pattern is unique to periods of higher interest rate volatility and does not hold during periods when the implied volatility of the S&P 500 (VIX) is elevated. Turning to the cross-section of issuers, we expect a stronger SOFR discount for safer issuers because the additional price stability is most visible for FRNs with low credit risk. In line with this view, the SOFR discount is strongest for the safest issuers in our sample. This cross-sectional variation in the SOFR discount also suggests that our results are specific to the FRN market and not simply driven by the spread pricing in derivatives markets.

In the third and final part of the paper, we investigate how legal concerns around the benchmark transition affect the observed patterns. Because FRNs that mature after LIBOR ceases to exist expose investors to more legal risks (e.g., borrowers might refuse to pay the higher yield spread over SOFR), we test if the SOFR discount is stronger for FRNs that mature after the planned LIBOR cessation date. While we find a larger SOFR discount for FRNs that mature after the cessation date, the SOFR discount remains statistically and economically significant for FRNs that mature before the cessation date. We further investigate how the announcement to postpone the cessation of LIBOR from December 2021 to June 2023 affects the pricing of FRNs. Consistent with an adverse impact of legal uncertainty, we find a small but statistically price increase of approximately one basis point for FRNs that reference LIBOR between December 2021 and June 2023.

This is the first evidence showing the benchmark transition had a *positive* effect on borrowing conditions in floating rate debt markets. Hence, we add an important dimension to the current policy debate about using credit-sensitive rates in debt markets. Policy makers in other jurisdictions, such as the Euro-area and Japan, also consider transitioning from credit-sensitive term rates to reference rates based on overnight rates (e.g., Tuckman, 2023) and our results suggest FRN issuers would benefit from such a transition. However, FRNs are issued by GSEs, large banks, and multinational corporations while many concerns around the benchmark transition focus on the syndicated loan market. In the Internet Appendix of this paper, we explain the challenges to quantifying the impact of the benchmark transition on loan spreads but find a qualitatively similar SOFR discount in the loan market. This SOFR discount does not eliminate the concern that the benchmark transition adversely affects future loan supply.

Related literature

Despite its impact on financial markets, the benchmark transition has received little attention in the academic literature. To the best of our knowledge, this is the first paper to empirically link the cost of borrowing floating-rate debt and benchmark rates. According to Schrimpf and Sushko (2019) and Klingler and Syrstad (2021), the most significant change when switching from LIBOR to alternative reference rates is the loss of the term premium. Jermann (2019), Cooperman et al. (2022), Kirti (2022), and Jermann (2023) argue that loans benchmarked against a manipulation-free and credit-sensitive benchmark offer a natural funding hedge to investors. While the loss of credit-sensitivity is a key concern for the LIBOR-SOFR transition, we find no evidence of elevated borrowing costs for SOFR-linked debt. Instead, borrowers benefit from lower costs by issuing SOFR-linked debt.

Our findings also contribute to the growing literature on the convenience premium of safe assets. Investors in US Treasuries traditionally accept yields below other proxies of the risk-free rate for the convenience of holding safe and liquid assets (e.g., Longstaff, 2004; Krishnamurthy and Vissing-Jorgensen, 2012; Nagel, 2016, among many others). The concept of a convenience premium expands to other sovereign bond markets (e.g., Diamond and Van Tassel, 2021;

Christensen et al., 2021) and privately issued debt (e.g., Kacperczyk et al., 2020; He and Song, 2022). More recently, Fleckenstein and Longstaff (2023) expand the notion of convenience premiums by highlighting that US municipal bonds carry a convenience premium due to their tax status. Closest to our paper, Fleckenstein and Longstaff (2020) find that MMFs pay a convenience premium for the mark-to-market stability of Treasury FRNs. Building on their results, we explain the SOFR discount with the higher price stability of SOFR-linked FRNs. Our contribution to this literature is to document that the stability premium investors pay for FRNs depends on the type of reference rate. FRNs linked to overnight rates instead of term rates carry an additional convenience premium due to their enhanced price stability.

1. The transition from LIBOR to SOFR

LIBOR was originally introduced as a variable rate that allows banks to charge syndicated loan borrowers a spread over their own funding costs (e.g., Vaughan and Finch, 2017). It has been the primary benchmark rate for loans and floating rate debt since the 1980s.

The LIBOR manipulation scandal and a shrinking interbank debt market (Wheatley, 2012) led to a transition from LIBOR to alternative benchmark rates. In July 2017, the agency overseeing LIBOR announced plans to cease the publication of LIBOR after December 2021 (Bailey, 2017). Afterwards, the Alternative Reference Rates Committee (ARRC) recommended SOFR – an overnight rate calculated as weighted average of repo agreements in the US Treasury market – as alternative reference in the US (ARRC, 2017). In November 2020, the benchmark administrator postponed the cessation date for US LIBOR from December 2021 to June 2023 (attorneys, 2020) and in July 2021 regulators banned the issuance of securities with LIBOR-related payments after December 2021 (FDIC, 2021).[1]

1.1. Qualitative differences between LIBOR and SOFR

The main issue with the benchmark transition, highlighted by both market participants and academics is the *qualitative difference* between LIBOR and SOFR. LIBOR contains a term premium that compensates investors for the credit risk of the borrower and the cost of committing funds over a fixed term (e.g., Filipović and Trolle, 2013). Because of this term premium, LIBOR increases in times of financial distress. Schrimpf and Sushko (2019) and Klingler and Syrstad (2021) show collateralized overnight rates tend to remain stable during times of financial distress. Highlighting the qualitative differences between LIBOR and SOFR, they also note that an alternative reference rate based on compounded overnight SOFR rates does not contain a term premium.

The ongoing attempt to establish a credit-sensitive alternative benchmark rate highlights that the qualitative differences between LIBOR and SOFR are a first-order concern for financial markets. Examples of credit sensitive benchmark rates are the Across-the-Curve Credit Spread Indices (AXI) developed by Berndt et al. (2022), Ameribor, the Bloomberg Short-Term Bank Yield Index (BSBY), the ICE Bank Yield Index, and the IHS Markit Credit Spread adjustment. The attempts to establish credit sensitive alternative rates face strong opposition from regulators. For instance, even though BSBY was widely accepted as alternative credit-sensitive reference rate – the Chicago Mercentile Exchange (CME) even listed futures contracts on the rate – the U.S. Securities and Exchange Commission (SEC) stopped the attempt to establish BSBY as credit-sensitive alternative benchmark rate. In September 2021, the SEC noted that “BSBY has the same inverted-pyramid problem as LIBOR” (Gensler, 2021). In July 2023, regulators further argued that neither BSBY nor Ameribor are compliant with the principles for financial benchmarks, effectively banning them as alternative reference rates (e.g., Bartholomew, 2023).

1.2. Transitioning cashflows from LIBOR to SOFR

For securities that reference LIBOR and mature after the LIBOR cessation, the cashflows must transition to referencing an alternative rate. While Duffie (2018) and Zhu (2019) suggested auction mechanisms to convert these instruments to new reference rates, regulators have taken a simpler approach. For derivatives contracts, the International Swaps and Derivatives Association (ISDA) addressed the issue by implementing a fallback protocol that replaces LIBOR with compounded SOFR (in arrears) plus the five-year historical median spread between LIBOR and the compounded SOFR (ISDA, 2019). This fallback was fixed on March 5, 2021 at 26.161 basis points. Following the ISDA, the ARRC recommended the same fallback language for FRNs (ARRC, 2021). This recommendation was widely anticipated and already communicated in ARRC (2019).

The most common payment frequencies for floating rate debt are quarterly, monthly, or semi-annual. While LIBOR rates with 1-, 3-, and 6-month tenors were readily available, SOFR is an overnight rate and term rates with different tenors are not directly available. To obtain term rates based on SOFR, the market convention for most floating rate debt is to use “in arrears” compounding where the rate paid at time t is the compounded overnight rate between $t-1$ and t (ARRC, 2021). In contrast to term LIBOR, which is known at time $t-1$, the compound SOFR is only known at time t, that is, when an interest payment is due. To allow enough time to arrange the interest payments, the convention for FRNs (e.g., ARRC, 2019) and SOFR swaps (e.g., Barnes, 2020; Huggins and Schaller, 2022) is to shift the compounding period backward by several business days.[2]

To illustrate how the LIBOR-SOFR transition affected the cashflows of FRNs, we consider the example of a FRN issued by UBS that matures at January 21, 2027 (CUSIP: BX9601184). The FRN was issued on January 21, 2021 and originally referenced 3-month LIBOR. Between April 2021 and July 2023, investors received quarterly interest payments equal to the 3-month LIBOR rate plus a spread of 100 basis points.[3] Once LIBOR rates became unavailable, the cashflows of the security were amended according the official recommendations. The variable rate changed from 3-month LIBOR to the compounded SOFR rate and the spread increased from 100 basis points to 126.161 basis points.

2. The data

The benchmark transition in the primary market for FRNs started in July 2018 when Fannie Mae issued the first SOFR-linked FRN (Rozens, 2018) and ended in December 2021 when the issuance of LIBOR-linked FRNs stopped after US regulators announced in July 2021 that no LIBOR contracts should be issued after December 2021 (FDIC, 2021). This transition period provides an ideal laboratory to study how benchmark rates affect borrowing costs as we can compare the yield spreads of FRNs from different issuers.

We assemble a comprehensive dataset of FRNs issued between July 2018 and December 2021 using the Bloomberg system.[4] Our starting point is all dollar-denominated fixed income securities with floating

[1] We focus our descriptions and analysis on USD LIBOR because dollar-denominated floating-rate debt volumes are by far the largest. In other currencies, such as British pounds and Swiss francs, the publication of LIBOR stopped by the end of 2021.

[2] An alternative to compounding in arrears are forward-looking term rates based on SOFR futures contracts (e.g., Tuckman, 2023). The official (ARRC, 2019) recommendation was to use in-arrears compounding only if forward-looking term rates are not available. As discussed by Bartholomew (2021), the development of these term rates has been slow during our sample period.

[3] Because the cashflows at time t reference the LIBOR rate observed at time $t-1$, the cashflows did not change immediately after the official discontinuation of LIBOR in July 2023. The cashflow in July 2023 was linked to the 3-month LIBOR rate observed in April 2023.

[4] An alternative data source would be the Mergent Fixed Income Securities Database (FISD). The drawback of using FISD is that it only contains 27% of the FRNs obtained through Bloomberg. Despite this smaller sample, our main result remains intact when using the FISD sample.

Table 1
FRN summary statistics. This table provides summary statistics for our sample of FRN issuance data. Issuance amounts are in billion USD. Under *TTM*, *Amt*, and Issuance Spread, we report the average time to maturity (in years), issuance amount (in billions), and issuance spreads separately for LIBOR-linked and SOFR-linked FRNs. *#YMs both* counts the number of months in which we observe issuance of both LIBOR-linked and SOFR-linked FRNs by the same issuer. We require at least two year-months with both LIBOR-linked and SOFR-linked FRNs to include the issuer in this table.

		Total	# FRNs		*TTM*		*Amt*		Issuance Spread		#YMs
		Issued	LIBOR	SOFR	LIBOR	SOFR	LIBOR	SOFR	LIBOR	SOFR	both
	Total (all issuers)	2268.82	5610	1563	1.08	1.34	0.25	0.54	17.12	17.68	37
(1)	FHLBs	820.06	792	325	0.94	1.27	0.53	1.22	−9.12	6.90	7
(2)	Fed Farm	183.83	307	204	1.38	1.75	0.27	0.50	−2.35	8.47	27
(3)	Sumitomo Mitsui Fin.	97.13	309	50	0.63	0.66	0.28	0.24	16.04	15.94	10
(4)	Bk of Montreal	90.20	271	92	0.90	0.95	0.26	0.21	15.06	21.23	20
(5)	Bk of Nova Scotia	65.94	203	64	0.91	1.09	0.24	0.28	14.67	17.31	3
(6)	CIBC	59.79	214	47	0.91	1.15	0.22	0.28	16.10	24.89	11
(7)	Royal bk of Canada	52.15	182	55	0.99	0.95	0.26	0.10	15.53	20.78	16
(8)	Cred. Suisse	43.07	74	98	1.06	0.88	0.25	0.25	31.70	36.54	14
(9)	Mizuho	42.30	226	12	0.57	0.55	0.18	0.15	15.81	13.75	2
(10)	BNP Paribas	42.17	183	27	0.76	0.78	0.20	0.20	18.14	16.33	7
(11)	BPCE	36.06	140	35	2.09	1.76	0.19	0.27	33.10	30.09	10
(12)	TD	35.46	127	20	0.93	1.71	0.22	0.36	18.50	26.58	5
(13)	Rabobank	28.77	205	23	0.83	0.79	0.13	0.09	13.89	12.09	5
(14)	Std Chartered	26.39	139	23	0.66	0.96	0.17	0.14	16.55	20.78	6
(15)	Sumitomo Mitsui Trust	25.33	87	32	0.56	0.66	0.22	0.19	17.56	16.06	2
(16)	Toyota	21.22	16	11	1.49	1.50	0.57	1.10	17.84	28.00	2
(17)	Westpac	20.49	76	23	1.17	1.21	0.19	0.26	14.04	17.91	3
(18)	Cred. Agricole	19.93	98	21	1.05	0.96	0.17	0.15	21.64	19.48	5
(19)	Cmlth. bk of Australia	17.50	70	22	0.88	1.44	0.16	0.28	17.31	21.45	2
(20)	HSBC	15.39	103	12	0.80	0.80	0.13	0.13	18.11	25.75	2
(21)	Oversea-Chinese Bk	12.70	65	14	0.66	0.70	0.16	0.17	11.35	16.86	4
(22)	Farmer Mac	11.27	94	79	1.22	2.86	0.09	0.03	−3.38	12.35	17
(23)	Lloyds	9.38	66	17	0.89	1.09	0.12	0.08	26.69	28.06	5
(24)	KB Fin.	4.09	62	3	1.16	1.33	0.06	0.15	34.48	40.67	2

coupon payments and we use the term FRNs for this sample throughout the paper (even though some securities have a maturity below one year and are therefore, technically not "notes"). To obtain spreads for comparable securities, we apply the following six filters.

First, we remove subordinated, securitized, and guaranteed debt and focus on non-exotic floaters that pay at maturity (bullet bonds), are issued at par, and do not have a coupon cap or floor.[5] Second, we require a time to maturity between six months and ten years, excluding the few notes with longer maturity. Third, to ensure that the spreads are comparable to those of swaps, we only include securities with a daycount convention of ACT/360, which are the vast majority and exactly mirror the payment conventions in swaps. Fourth, we only include floaters with LIBOR or SOFR as benchmark rate. For SOFR-linked debt, we restrict the sample to securities with the same benchmark rate as SOFR OIS (Bloomberg ticker: SOFRRATE). For LIBOR-linked debt, the majority of FRNs either references the 1-month or 3-month LIBOR rate (Bloomberg tickers: US0001M or US0003M) and we include both benchmarks in our analysis. Fifth, we drop FRNs with missing issuance date, issuance amount, or spread information. Finally, because our focus is on SOFR-linked debt, we only include borrowers that issue at least one SOFR-linked FRN during our sample period.

Taken together, these filters result in 7173 FRN issuances from 56 individual borrowers. Table 1 contains summary statistics of our filtered sample. Starting with the full sample, the first row shows that we observe a total issuance volume of $2.3 trillion with 5610 LIBOR-linked and 1563 SOFR-linked FRNs, respectively. The average time to maturity is 1.08 years for LIBOR-linked FRNs and 1.34 years for SOFR-linked FRNs. The average issuance amount is $0.25 billion for LIBOR-linked FRNs and $0.54 billion for SOFR-linked FRNs. We provide additional details on the distribution of maturities and issuance sizes for our sample in Figures IA.1 and IA.2 in the Internet Appendix.

The key variable of interest for our analysis is the spread the FRNs pay over their reference rates. Throughout the paper, we refer to this spread as *issuance spread*. Other common names are "quoted margin" (e.g., Fabozzi and Mann, 2000, CFA Institute, 2019) and "index spread" (e.g., Choudhry, 2010). We refer to the interaction between year and month (e.g., July 2021) as "year–month" (YM) and focus the summary statistics in Table 1 on issuers with at least two year-months of issuing both LIBOR-linked and SOFR-linked FRNs.

As we can see from the table, the two largest issuers in our sample are US GSEs, which account for more than one third of the FRN issuance volume in our sample. Moreover, the most common issuer type is major bank holding companies with headquarters outside the US, followed by multinational companies. While the average issuance spread is around 17 basis points for both LIBOR and SOFR-linked FRNs in the full sample, examining the average issuance spreads across issuers reveals that SOFR-linked issuance spreads are typically higher than LIBOR-linked spreads. As we explain in Section 3, comparing the raw issuances spreads is missleading because the variable rate in LIBOR-linked FRNs is higher than the variable rate in SOFR-linked FRNs.

Fig. 1 shows quarterly issuance volumes of the FRNs in our sample. These issuance volumes are substantial, ranging from $50 billion to $300 billion. Fabozzi and Mann (2000) note that FRNs are more popular during times of increasing interest rates. In line with this notion, Fig. 1 shows substantially larger issuance volumes before the first quarter of 2020, when the outbreak of the Corona pandemic led to a drop in US target interest rate to near-zero. Moreover, the fraction of FRNs benchmarked against SOFR increases over time from 0.3% in Q3 2018 to 97% in Q4 2021. In the Internet Appendix, we show that FRN issuance picked up again with the rate hikes in 2022 and approximate the outstanding notional of the FRNs in our sample, which ranges from a peak of $911 billion in March 2020 to $435 in December 2021 (see Figures IA.3 and IA.4). These volumes exceed the outstanding notional

[5] This filtering includes removing structured notes, insured or covered bonds, and inflation-linked notes. We remove all FRNs with a coupon cap from our analysis but allow a coupon floor of zero. Approximately one third of all FRNs in the filtered sample have a coupon floor equal to zero and our conversations with market participants suggest that this floor is only a contract detail to avoid negative interest payments. In practice, FRN spreads are generally positive and, more importantly, US monetary policy did keep a zero-lower bound on interest rates throughout our sample period. See also Fleckenstein and Longstaff (2020) for a similar discussion of the floor in Treasury FRNs.

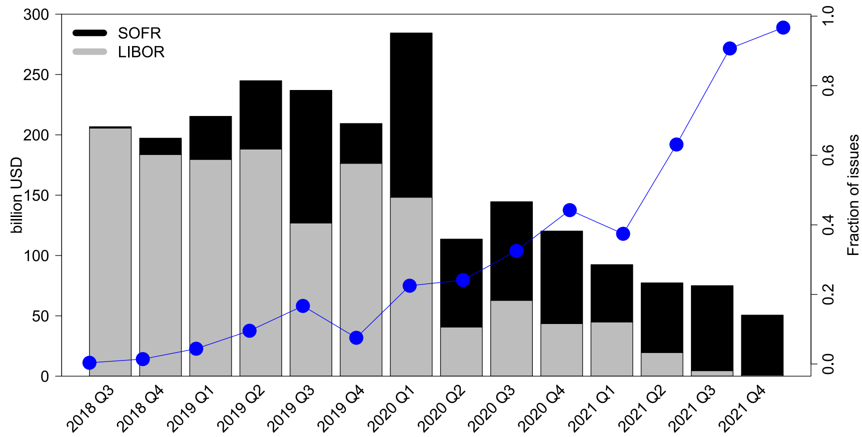


Fig. 1. FRN issuance volumes. This figure shows the notional amounts of FRNs issued against SOFR (black bars) or LIBOR (grey bars). The blue dots represent the number of FRNs benchmarked against SOFR, divided by the total number of FRNs issued in the same month.

of Treasury FRNs, which ranges up to $620 billion according to Hartley and Jermann (2024).

An interesting question is why borrowers issue FRNs with different reference rates within the same month. While one reason for starting to issue SOFR-linked FRNs is pressure from regulators (e.g., Bailey, 2018 highlights that the transition to LIBOR "will happen"), concerns about the effect of the benchmark transition on the issuers assets (e.g., on their loan portfolios or derivatives contracts) can be a reason to keep issuing LIBOR-linked FRNs. Moreover, while it is common for smaller firms to specialize in issuing a certain type of debt instrument (e.g., Colla et al., 2013), large companies often diversify across debt instruments. In line with these arguments we show in the Internet Appendix (Table IA.12) that one main driver of issuing FRNs linked to both LIBOR and SOFR is the size of the FRN debt. Hence, even if the cost of issuing SOFR-linked debt differs systematically from the cost of issuing LIBOR-linked debt, these arguments give firms an incentive to issue FRNs linked to both reference rates. It is therefore not obvious if focusing on issuer-month with both LIBOR-linked and SOFR-linked debt issuance introduces a systematic bias to our analysis.

2.1. Secondary market data

An alternative way of comparing LIBOR-linked and SOFR-linked FRNs is to examine secondary market prices, which has the advantage that it does not require simultaneous issuance of LIBOR- and SOFR-linked FRNs. Moreover, focusing on secondary market data allows us to compare different measures of market liquidity between LIBOR-linked and SOFR-linked FRNs. We therefore obtain secondary market data for the FRNs in our sample from the Bloomberg system.

There are two drawbacks to focusing on secondary markets instead of primary markets. First, while comparing issuance spreads in primary markets allows us to quantify the costs or benefit of switching from LIBOR to SOFR from the perspective of borrowers, it is less obvious how a spread in secondary market prices translates into a cost or benefit for the borrower. Second, prices are only available for a small subsample of our data. After applying basic filters, such as excluding FRNs with negative bid–ask spreads, we only observe secondary-market prices for 4% of the FRNs in our sample. This share increases to 12% when focusing on FRNs with more than one year to maturity because the Bloomberg system does not contain prices for FRNs with less than one year to maturity.[6]

[6] Because the Bloomberg system contains few prices for FRNs referencing 1-month LIBOR, we drop these observations and focus on the FRNs referencing either SOFR or 3-month LIBOR.

Table 2 contains summary statistics for our sample of secondary market prices for all issuers with simultaneous price quotes for LIBOR-linked and SOFR-linked FRNs. Compared to the issuer sample in Table 1, overlapping FRN data are not available for US GSEs and several large international banks. The average bid–ask spread for all FRNs in our secondary-market sample is 35 cents on $100 and more than 30 times higher than the average bid–ask spread of Treasury FRNs (Fleckenstein and Longstaff, 2020). The key variable of interest when examining the relative pricing of FRNs in the secondary market is the "discount margin", which captures the FRN spread that is consistent with the current price of the FRN and comparable to the yield spread of a fixed-rate bond (e.g., Fabozzi and Mann, 2000).

3. Comparing FRNs with different reference rates

To examine if SOFR-linked debt costs borrowers more or less than LIBOR-linked debt, we need to ensure the cashflows of debt instruments with different benchmark rates are comparable. We illustrate our approach for adjusting the issuance spreads by considering the hypothetical situation in which we observe the issuance spreads of two virtually identical FRNs. Both FRNs have a maturity of two years, quarterly cashflows, and are issued by the same borrower. The only difference is the interest payments of the first FRN are linked to 3-month LIBOR while those of the second are linked to SOFR.

Column (2) of Table 3 shows the cashflows from investing in the LIBOR-linked FRN, which comprise a fixed issuance spread IS^L plus the variable LIBOR payments ℓ_{t-1}. Following market conventions, the LIBOR rate paid at time t is determined at time $t-1$. Column (3) shows the cashflows of a LIBOR swap in which the three month LIBOR rate is exchanged against a fixed rate every quarter.[7] Column (4) shows that combining the cashflows of the FRN with those of the LIBOR swap results in fixed cashflows equal to the issuance spread and fixed LIBOR swap rate. Column (5) shows the cashflows from investing in the SOFR-linked FRN comprise the issuance spread IS^S and the variable payment s_t, which we use as short-hand for the compounded overnight SOFR rate between time $t-1$ and time t. Column (6) shows the cashflows of a SOFR OIS in which both parties exchange quarterly payments with the variable rate being equal to s_t. Together, these two positions result in fixed cashflows equal to IS^S and the fixed rate of the SOFR OIS, as shown in Column (7).

[7] In practice, in a dollar-denominated interest rate swap, the three-month LIBOR rate is paid quarterly while the fixed rate is paid semi-annually. For SOFR OIS fixed and variable payments are exchanged annually (or, for shorter maturities, at the maturity of the contract). We outline our approach for adjusting the cashflows of swaps below and provide a detailed explanation of our approach in Internet Appendix A.4.

Table 2
Summary statistics for secondary market pricing. This table provides summary statistics for the FRNs in our sample with available pricing data in Bloomberg. We only report issuers with at least two days with both LIBOR-linked and SOFR-linked FRNs outstanding. Issuance amounts are in billion USD. Under *TTM*, *Bid–Ask(%)*, and *Disc. Margin*, we report the average time to maturity (in years), bid–ask spread (as percentage of mid price), and discount margin separately for LIBOR-linked and SOFR-linked FRNs #days both counts the number of days in which we observe prices of both LIBOR-linked and SOFR-linked FRNs by the same issuer.

		Total	# FRNs		*TTM*		*Bid–Ask(%)*		*Disc. margin*		#days
		Issued	LIBOR	SOFR	LIBOR	SOFR	LIBOR	SOFR	LIBOR	SOFR	both
(1)	Royal bk of Canada	52.15	6	1	3.67	1.29	0.37	0.09	43.15	18.61	343
(2)	BPCE	36.06	25	5	4.99	6.33	0.49	0.33	95.43	71.77	42
(3)	TD	35.46	4	7	2.25	2.25	0.22	0.26	31.18	29.93	458
(4)	Toyota	20.66	7	7	1.12	1.39	0.17	0.11	22.73	19.37	212
(5)	Westpac	20.49	2	2	2.93	4.41	0.33	0.25	49.24	41.41	146
(6)	Caterpillar	7.15	8	3	1.38	2.38	0.23	0.15	26.63	16.28	126
(7)	Export–import bk Korea	3.71	3	3	2.63	3.40	0.30	0.37	38.91	28.60	205
(8)	John Deere	3.65	6	2	1.60	2.41	0.18	0.16	20.57	17.15	45
(9)	Korea dev bk	3.25	4	1	2.61	3.69	0.29	0.39	39.62	25.83	157
(10)	Emirates bk	2.54	14	2	4.16	1.94	0.54	0.43	159.91	84.09	36
(11)	Inter-am dev bk	2.10	1	1	1.62	1.84	0.06	0.06	3.58	18.38	488
(12)	General Motors	1.90	1	3	2.02	2.52	0.41	0.15	124.47	58.38	49
(13)	Ntl rural util.	0.90	2	1	0.91	2.89	0.14	0.15	8.88	31.15	12
(14)	Duke Energy	0.80	1	1	1.27	1.72	0.16	0.29	25.06	24.57	20

Table 3
Comparing the cashflows of LIBOR and SOFR FRNs. This table illustrates how an investor can convert the variable-rate payments in a two-year FRN to fixed rate payments. ℓ_{t-1} and L_0 are the LIBOR rate at time $t-1$ and the fixed rate of the LIBOR swap, settled at time zero. s_t and S_0 are short-hand for the compounded average SOFR rate between $t-1$ and t and the SOFR OIS rate, settled at time zero, respectively. IS^L and IS^S are the issuance spreads of the LIBOR-linked and SOFR-linked FRN, respectively. The rates and issuance spreads in this table all reflect quarterly payments instead of annualized rates.

Time	LIBOR FRN			SOFR FRN		
	FRN	LIBOR swap	Total cash flow	FRN	SOFR swap	Total cash flow
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0.00	−1	–	−1	−1	–	−1
0.25	$IS^L + \ell_{0.00}$	$L_0 - \ell_{0.00}$	$IS^L + L_0$	$IS^S + s_{0.25}$	$S_0 - s_{0.25}$	$IS^S + S_0$
0.50	$IS^L + \ell_{0.25}$	$L_0 - \ell_{0.25}$	$IS^L + L_0$	$IS^S + s_{0.50}$	$S_0 - s_{0.50}$	$IS^S + S_0$
0.75	$IS^L + \ell_{0.50}$	$L_0 - \ell_{0.50}$	$IS^L + L_0$	$IS^S + s_{0.75}$	$S_0 - s_{0.75}$	$IS^S + S_0$
1.00	$IS^L + \ell_{0.75}$	$L_0 - \ell_{1.00}$	$IS^L + L_0$	$IS^S + s_{1.00}$	$S_0 - s_{0.25}$	$IS^S + S_0$
1.25	$IS^L + \ell_{1.00}$	$L_0 - \ell_{1.00}$	$IS^L + L_0$	$IS^S + s_{1.25}$	$S_0 - s_{1.25}$	$IS^S + S_0$
1.50	$IS^L + \ell_{1.25}$	$L_0 - \ell_{1.25}$	$IS^L + L_0$	$IS^S + s_{1.50}$	$S_0 - s_{1.50}$	$IS^S + S_0$
1.75	$IS^L + \ell_{1.50}$	$L_0 - \ell_{1.50}$	$IS^L + L_0$	$IS^S + s_{1.75}$	$S_0 - s_{1.75}$	$IS^S + S_0$
2.00	$1 + IS^L + \ell_{1.75}$	$L_0 - \ell_{1.75}$	$1 + IS^L + L_0$	$1 + IS^S + s_{2.00}$	$S_0 - s_{2.00}$	$1 + IS^S + S_0$

Because the cashflows in Columns (4) and (7) are both fixed and equally risky, the law of one price implies the following link between the issuance spread IS^L of the LIBOR-linked FRN and the issuance spread IS^S of the SOFR-linked FRN:

$$IS^L + L_0 = IS^S + S_0, \tag{1}$$

where L_0 and S_0 are the fixed rate of the LIBOR swap and the SOFR OIS, respectively. For our main analysis, we use a modified version of this hedging argument and change the variable cashflows of SOFR-linked FRNs from SOFR to LIBOR by combining a fixed receiver position in the SOFR swap with a fixed payer position in the LIBOR swap. Hence, we compare the issuance spread of LIBOR-linked FRNs to those of SOFR-linked FRNs according to the following equation:

$$IS^L = IS^S - (L_0 - S_0). \tag{2}$$

Focusing on the adjusted issuance spreads in Eq. (2) instead of the fixed rates from Eq. (1) is useful for illustrating differences over time because yield spreads are less affected by changes in policy rates than fixed rates. However, we show in the Internet Appendix that our main result remains virtually unchanged when we instead focus on fixed rates or on yield spreads where we swap the LIBOR-linked cash flows to SOFR.

The hedging argument outlined in Table 3 rests on swap contracts in which both fixed and floating leg are exchanged at the same time as the variable-rate payments of FRNs. In practice, the cashflow timing of LIBOR swaps and SOFR OIS does not perfectly align with the payment frequencies of FRNs. In addition, our sample includes LIBOR-linked FRNs linked to 1-month LIBOR or 3-month LIBOR. To obtain fixed rates that match the payment schedules of the FRNs in our sample, we bootstrap matching forward rates by combining LIBOR (swap) rates, tenor basis swap rates, and SOFR OIS rates. We provide the details of this approach in Internet Appendix A.4 and highlight in Internet Appendix Table IA.4 that these adjustments have a negligible effect (of around 0.1 basis points) on our empirical estimates. Moreover, to avoid our results being driven by sporadic outliers, we use weekly averages of all rates to obtain the spread adjustments. In Internet Appendix Table IA.5, we show that using the most recent observation instead of weekly averages has virtually no effect on our estimates.

To conclude this section, we note that our approach is inspired by Fleckenstein and Longstaff (2020), who use a combination of LIBOR swaps and T-bill/LIBOR basis swaps to convert the cashflows of Treasury FRNs into fixed cashflows. Hartley and Jermann (2024) point out that T-bill/LIBOR basis swaps have low transaction volumes. Because we use the spread between two liquidly-traded swap contracts in our analysis, the concern raised by Hartley and Jermann (2024) is less relevant in our context. In addition, we show in the Internet Appendix (Table IA.4) that using adjustments based on other derivatives contracts, such as rate futures and basis swaps, leaves our main results unchanged.

4. The SOFR discount

In this section, we examine the relative pricing of LIBOR-linked and SOFR-linked FRNs, proceeding in two steps. First, we focus on primary markets and use adjusted issuance spreads from FRN issuances to examine how the LIBOR-SOFR transition affected borrowing costs. Second, we examine secondary market prices and use the adjusted discount margins to examine the pricing effects of the LIBOR-SOFR transition.

4.1. Primary markets

Our preferred approach to test if the issuance spreads of SOFR-linked FRNs differ from the yield spreads of LIBOR-linked FRNs, is to run panel regressions of the following form:

$$s_{j,i,t} = \alpha_{SOFR} + \alpha_{1m} + Controls_{j,i,t} + \varepsilon_{j,it}. \quad (3)$$

The dependent variable is the adjusted issuance spread $s_{j,i,t}$ of FRN j, from borrower i, issued in month t. The main variable of interest in our analysis is a fixed effect α_{SOFR} that captures if the benchmark rate in the FRN is SOFR. A positive α_{SOFR} would confirm the concern that the borrowing costs associated with SOFR-linked debt are higher than for LIBOR-linked debt while a negative α_{SOFR} is in line with a SOFR discount. We control for α_{1m}, which captures if the benchmark rate in the FRN is 1-month LIBOR. Because we do not include a coefficient for the 3-month LIBOR benchmark, α_{SOFR} captures the spread between SOFR-FRNs and FRNs with 3-month LIBOR as benchmark rate. Similarly, α_{1m} captures the spread difference between FRNs linked to 1-month LIBOR and FRNs linked to 3-month LIBOR.

As a starting point of our analysis, we control for three maturity categories: Less than one year, one to three years, and more than three years. This approach is inspired by Liao (2020), who studies bond yields across currency denominations. We interact the maturity categories with year-month fixed effects to absorb any fluctuations in the term structure over time. Throughout the paper, we use the term year-month (YM) as the interaction between year and month (i.e., a monthly time fixed effect). To control for the credit quality of the issuer, we first use rating-category fixed effects based on ratings from Standard and Poor's. This approach has the drawback that the credit quality of the borrower can still vary substantially within rating categories. We therefore exploit the fact that we observe LIBOR- and SOFR-linked FRN issuances from the *same issuer in the same month* and use the more conservative approach of controlling for issuer fixed effects. Again, we interact these fixed effects with year-months to absorb any fluctuations in credit risk over time.[8]

Columns (1) and (2) of Table 4 show the estimates of α_{SOFR} when controlling for rating-category and issuer fixed effects, respectively. We observe a *SOFR discount* of −6.60 basis points for rating-category fixed effects which drops to −4.83 basis points when controlling for issuer-fixed effects instead. We further discuss the difference between rating and issuer fixed effects in the Internet Appendix (Table IA.3), where we also experiment with Credit Default Swap (CDS) premiums as additional control.

We next explore the effect of more conservative controls. First, because issuance size is correlated with liquidity in the secondary market, we control for the issuance amount $\log(Amt)$, interacted with year-month fixed effects. However, as shown in Column (3) adding issuance size has virtually no effect on our estimates. Next, we replace the maturity categories with a continuous control capturing the time to maturity. Column (4) shows that the SOFR discount remains virtually unchanged after this modification. As pointed out by Nyborg and Woschitz (2024), controlling for non-linearities in the term structure can have a significant impact on regression estimates. To address this concern, we control for time to maturity to the power of two and three. Column (5) shows the SOFR discount remains qualitatively similar at −4.58 when controlling for these non-linearities.[9]

[8] As we explain in more detail later, controlling for interactions between dependent variables and year-month fixed effects is comparable to first running cross-sectional monthly regressions and then calculating the average α_{SOFR}.

[9] We also note that tightening our regression specification leads to a substantial drop in the effect of 1-month LIBOR rates. This effect reduces from −6.15 basis points in Column (1) to −0.87 basis points in Column (5). We discuss potential explanations for this small discount for FRNs linked to 1-month LIBOR in Section 5.

Table 4
Estimating the SOFR discount. This table shows the results of regressing the adjusted issuance spreads for our sample of newly-issued FRNs on two indicator variables: $SOFR$ equals one if the benchmark rate is SOFR and zero otherwise; $1m$ equals one if the benchmark rate is the 1-month Libor rate. We do not add an indicator for 3-month LIBOR, which corresponds to the baseline case. The issuance spreads are adjusted by adding the matched fixed rates from interest rate swaps. Column (1) shows the results controlling for rating times time fixed effects. Columns (2) to (5) show the results with issuer times time fixed effects. The additional controls are as follows. In Columns (1) and (2), we add maturity category times time fixed effects (using the categories $< 1y$ $(1y, 3y]$, and $> 3y$)). In Column (3) to (6), we add $\log(Amt)$, interacted with time fixed effects, as control. In Column (4), we add TTM interacted with time fixed effects. In Column (5), we add TTM, TTM^2, and TTM^3, all interacted time fixed effects. Time fixed effects are captured at the year-month level. The numbers in parentheses are t-statistics based on heterogeneity-robust standard errors, clustered at the issuer and year–month level. ***, **, and * indicate significance at a 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)
$SOFR$	−6.60***	−4.86***	−4.98***	−4.97***	−4.58***
	(−4.35)	(−4.04)	(−3.90)	(−3.57)	(−3.01)
$1m$	−6.15***	−3.16***	−3.12***	−1.29**	−0.87**
	(−4.08)	(−4.45)	(−4.30)	(−2.66)	(−2.13)
Fixed effects:					
Rating × YM	✓	–	–	–	–
TTM Categ. × YM	✓	✓	✓	–	–
Issuer × YM	–	✓	✓	✓	✓
$\log(Amt)$ × YM	–	–	✓	✓	✓
TTM × YM	–	–	–	✓	✓
TTM^2 × YM	–	–	–	–	✓
TTM^3 × YM	–	–	–	–	✓
Adj. R^2	0.83	0.92	0.92	0.94	0.94
Num. obs.	7173	7173	7173	7173	7173

To conclude this analysis, we estimate the total dollar savings associated with issuing SOFR-linked FRNs as follows:

$$Savings = \alpha_{SOFR} \times \sum_{i=1}^{7,173} TTM_i \cdot Amt_i \cdot \mathbb{1}_{Benchmark_i = SOFR}, \quad (4)$$

where we multiply with the time-to-maturity because the SOFR discount is based on annualized interest rates. Depending on which estimate of α_{SOFR} we use, the savings estimates during our sample period range from \$669 million to \$464 million.

To gain further perspective on these savings, we collect FRN issuance data for the year 2022 (Figure IA.4 shows the issuance volumes). Using Eq. (4), we estimate the total savings during this year alone range from \$597 million to \$414 million. Putting this dollar amount into perspective, the total issuance cost associated with the issuance spread over SOFR are \$4.523 million during the same period. Hence, the transition from LIBOR to SOFR saves FRN issuers between 13% and 9% in issuance costs.

4.1.1. Alternative specifications

An alternative to our approach of controlling for interactions between FRN characteristics and year-month fixed effects is to run monthly cross-sectional regressions and report the average of the α_{SOFR} estimates. The cross-sectional approach is sometimes referred to as "matrix pricing" (e.g., Liao, 2020) and produces qualitatively similar results to our results. To illustrate this point, Table IA.1 in the Internet Appendix shows the results of a two-step procedure (similar to Fama and MacBeth, 1973 regressions) where we first run monthly cross-sectional regressions and then examine the time series of the resulting coefficients. While the resulting SOFR discount is −4.39 and virtually identical to our previous estimate, the drawback of this procedure is that it relies on equal weights for each monthly observation while our panel approach puts higher weights on months with more available observations.

A second alternative to using panel regressions is to examine the spreads for pairs of comparable FRNs. To examine comparable FRNs, we proceed as follows. For each issuer-month with at least one LIBOR-linked and one SOFR-linked FRN, we first check if there are more

Table 5
Matched pairs comparison. This table shows estimates of the spread between SOFR-linked FRNs and LIBOR-linked FRNs from the same issuer within the same month. For each issuer-month with at least one SOFR-linked and one LIBOR-linked FRN issuance, if there are more SOFR-linked (LIBOR-linked) FRN issuances than LIBOR-linked (SOFR-linked) issuances, we use propensity score matching to find the FRN which matches most closely in terms of its time to maturity and issuance size. We then calculate the difference between the adjusted issuance spreads of SOFR-linked FRNs and LIBOR-linked FRNs. Column (1) shows the average spread difference. Column (2) shows the average spread difference separating pairs where the LIBOR-linked FRN pays the 1-month LIBOR rate. Columns (3) and (4) show the results also controlling for the difference in the time-to-maturity of the matched pairs and the difference in the issuance volume. The numbers in parentheses are t-statistics based on heterogeneity-robust standard errors. ***, **, and * indicate significance at a 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)	(4)
Spread difference	-3.07^{***}	-4.81^{**}	-4.04^{***}	-4.08^{***}
	(−2.84)	(−2.18)	(−2.66)	(−2.60)
$1m$		3.20	−1.28	−1.41
		(1.38)	(−1.17)	(−1.33)
TTM difference			13.94^{***}	14.02^{***}
			(4.71)	(4.59)
$\log(Amt)$ difference				0.41
				(0.53)
Adj. R^2	–	–	0.41	0.41
Num. obs.	421	421	421	421

LIBOR-linked issuances than SOFR-linked issuances. If that is the case, we use propensity score matching to find the closest matching LIBOR-linked FRN for each SOFR-linked FRN. We use "nearest neighbor" matching and focus on the time-to-maturity and issuance amount to find matches. Similarly, for months with more SOFR-linked FRNs, we find the closest matching SOFR-linked FRN for each LIBOR-linked FRN. This approach produces 421 matched pairs and allows us to directly examine the differences in the adjusted issuance spreads.

Column (1) of Table 5 shows an average spread of the matched pairs equal to −3.07 basis points. Column (2) shows that controlling for an indicator variable that equals one if the LIBOR-linked FRN in the pair is paying the 1-month LIBOR increases the coefficient to −4.81 basis points, which is comparable to our baseline estimate from panel regressions. As shown in Columns (3) and (4), adding the difference in time-to-maturity and the difference in issuance amount leaves the SOFR coefficient largely unchanged. We perform additional matching tests using the sample of US GSEs in the Internet Appendix (IA.7).

4.1.2. Additional robustness checks

We have also furnished an Internet Appendix (Tables IA.3 to IA.5) to highlight that the observed SOFR discount is robust to ten robustness tests: (i) controlling for the Credit Default Swap (CDS) premium for issuers with matching data; (ii) adding spread adjustments to different types of FRNs; (iii) using linear interpolation instead of constructed spread adjustments; (iv) adjusting with futures contracts instead of swaps; (v) adjusting with basis swaps instead of using a combination of interest rate swaps and OIS; (vi) using swap rates from the current day instead of weekly averages; (vii) dropping FRAs from our estimation procedure; (viii) interacting $\alpha 1m$ with year–month fixed effects; (ix) controlling for instrument type fixed effects, interacted with year–month fixed effects; (x) using subsamples with either more than one year to maturity or less than one year to maturity. In addition, we show in the Internet Appendix (Table IA.11) that using modified spread adjustments that take the issuance spread into account when discounting the swap-implied forward rates leave our results virtually unchanged.

4.2. Evidence from secondary markets

We adjust the observed discount margins using the same maturity-matched spread adjustments as for primary market issuance spreads. We then run panel regressions of the adjusted discount margins on

Table 6
Estimating the SOFR discount using secondary market prices. This table shows the results of regressing adjusted discount margins from our sample of secondary market prices on an indicator variable $SOFR$ that equals one if the benchmark rate is SOFR and zero otherwise. This sample does not include FRNs linked to 1-month LIBOR and we do not add an indicator for the 3-month LIBOR, which corresponds to the baseline case. The sample period in Columns (1) to (3) is July 2018 to December 2021. The sample period in Column (4) is January 2022 to July 2023. All specifications show the results with issuer times time fixed effects. The additional controls are as follows. In Column (1), we add maturity category times time fixed effects (using the categories $< 1y$ $(1y, 3y]$, and $> 3y$)). In Column (2) to (4), we add $\log(Amt)$ and $Bid--Ask$, interacted with time fixed effects, as control. In Column (3) and (4), we add TTM, TTM^2, and TTM^3, all interacted time fixed effects. Time fixed effects are captured at the year-month level. The numbers in parentheses are t-statistics based on heterogeneity-robust standard errors, clustered at the issuer and year-month level. ***, **, and * indicate significance at a 1%, 5%, and 10% level, respectively.

Sample period:	Jul 2018 to Dec 2021			Jan 2022 to Jun 2023
	(1)	(2)	(3)	(4)
$SOFR$	-11.71^{**}	-11.40^{***}	-10.63^{***}	-14.44^{***}
	(−2.45)	(−2.81)	(−3.07)	(−2.87)
Fixed effects:				
Issuer × YM	✓	✓	✓	✓
TTM Categ. × YM	✓	✓	–	–
$\log(Amt)$ × YM	–	✓	✓	✓
Bid–Ask × YM	–	✓	✓	✓
TTM × YM	–	–	✓	✓
TTM^2 × YM	–	–	✓	✓
TTM^3 × YM	–	–	✓	✓
Adj. R^2	0.93	0.94	0.95	0.95
Num. obs.	88,922	88,922	88,922	57,623

an indicator variable that equals one if the FRN is linked to SOFR (we drop the few 1-month LIBOR FRNs), and gradually add more stringent control variables, proceeding similar to Section 4.1. Columns (1) to (3) of Table 6 show the results using daily data from July 2018 to December 2021. Starting with issuer and maturity category fixed effects, Column (1) shows a SOFR discount of −11.71 basis points. As shown in Column (3), this discount lowers to −10.63 basis points when we control for more granular maturity effects, issuance size, and bid–ask spreads.

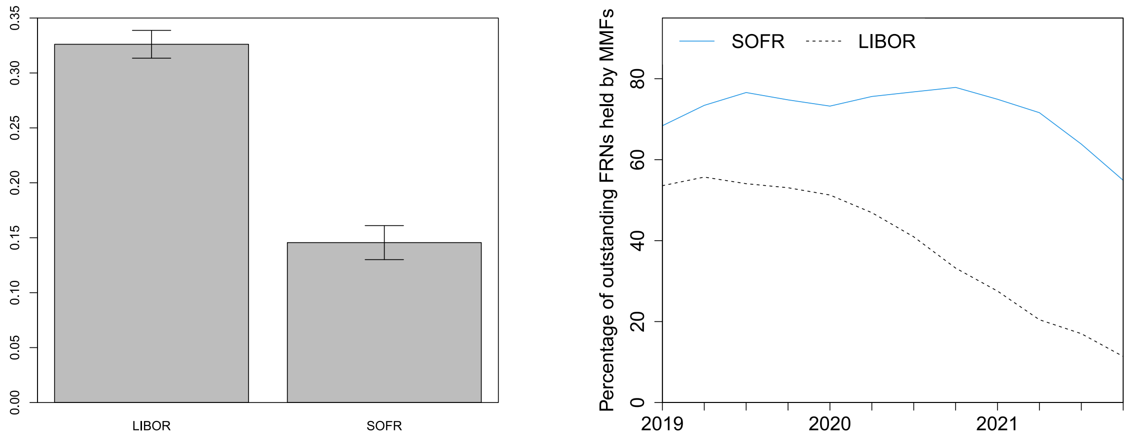
These estimates are substantially larger compared to our estimates for the primary market, despite potential issues with noisy secondary market data. One potential explanation for the larger economic significance in this specification compared to our main analysis is that we do not restrict our estimation to issuer-months when the same borrower chooses to issue FRNs with different benchmark rates. It is plausible that this restriction gives conservative estimates of the SOFR discount because a borrower might only issue FRNs with different reference rates if the spread between them is small.

We next expand our analysis to the January 2022 to July 2023 period. While we do not observe issuances of LIBOR-linked FRNs during this period, we can use the secondary market prices to examine the spread between FRNs with different reference rates. This is an out-of-sample test for our main analysis and has the advantage that any legal concerns related to the benchmark transition are likely settled. As shown in Column (4) of Table 6, the SOFR discount increases to −14.44 basis points, suggesting that our results expand beyond the transition period.

As we explain in Section 5, the higher price stability of SOFR-linked FRNs is a potential explanation for the SOFR discount. This higher price stability is more valuable during times of heightened interest rate volatility. A stronger SOFR discount during the January 2022 to June 2023 period, which saw substantial interest rate hikes and interest rate volatility, is consistent with this view.

4.2.1. Differences in market liquidity?

One potential concern with our analysis is that the SOFR discount might simply reflect differences in the market liquidity of SOFR-linked



(a) Price volatility (b) Percentage held by MMFs

Fig. 2. Price volatility and main investors. Panel (a) shows the average price volatility (volatility is computed quarterly for each FRN with available prices), separately for LIBOR-linked FRNs and SOFR-linked FRNs. The bars show 95% confidence intervals. Panel (b) shows MMF holdings of SOFR-linked FRNs or LIBOR-linked FRNs, expressed as percentage of the total notional amount outstanding (quarterly averages).

and LIBOR-linked FRNs. So far, we have controlled for market liquidity using the issuance volume of the FRN and the bid–ask spreads. In the Internet Appendix, we perform three additional tests which highlight that there is no significant difference in the market liquidity of SOFR-linked and LIBOR-linked FRNs.

First, we repeat our analysis from Table 6, replacing the dependent variable with the bid–ask spreads. As shown in Table IA.6 in the Internet Appendix, there is no significant difference between LIBOR-linked and SOFR-linked FRNs in terms of bid–ask spreads. Second, we perform propensity score matching similar to the results in Table 5 and analyze the spreads in adjusted discount margins and bid–ask spreads for the matched pairs. Table IA.7 in the Internet Appendix shows a SOFR discount ranging from −7.36 to −11.49 basis points for discount margins but no significant difference between the bid–ask spreads of LIBOR-linked and SOFR-linked FRNs. Finally, inspired by the corporate bond literature (e.g., Dick-Nielsen et al., 2021), we compare the (potential) underpricing of newly-issued LIBOR-linked and SOFR-linked FRNs. As in Dick-Nielsen et al. (2021), we calculate the issuance discount as the average difference between the issuance price and the secondary market price during the first two weeks after issuance. Table IA.8 in the Internet Appendix shows that there is no significant difference between the underpricing of LIBOR-linked and SOFR-linked FRNs.

5. An explanation for the SOFR discount

In this section, we offer an explanation for the SOFR discount. We start by showing that FRNs with variable-rate payments linked to an overnight rate instead of a term rate benefit from enhanced mark-to-market price stability. Because MMFs are a major investor in FRNs and value mark-to-market stability, this qualitative difference between LIBOR and SOFR is a likely explanation of the SOFR discount. We then provide two pieces of evidence consistent with this price stability hypothesis. First, in the time series, price stability matters more during periods of higher interest rate volatility. Second, in the cross-section, the price stability is most pronounced for safer issuers whose credit quality fluctuates less.

5.1. The higher price stability of SOFR-linked FRNs

The mark-to-market value of a FRN is typically affected by the issuer's default risk and the current level of the reference rate (Fabozzi and Mann, 2000). To understand how the current level of the reference rate can affect the prices of FRNs, recall that LIBOR-linked FRNs pay a term rate observed at the beginning of the payment quarter. Hence, after the LIBOR rate is observed, an increase in the LIBOR rate lowers the price of the FRN. By contrast, SOFR-linked FRNs pay the average overnight rate observed over the quarter. Because the average overnight rate responds to changes in interest rates, the price of SOFR-linked FRNs is unaffected by changes in interest rates (see Internet Appendix A or Tuckman and Serrat, 2022 for additional details).

To examine how price volatility varies between LIBOR-linked and SOFR-linked FRNs, we use our sample of secondary market quotes obtained from the Bloomberg system. Panel (a) of Fig. 2 shows that the average price volatility of LIBOR-linked FRNs is approximately twice as large as the price volatility of SOFR-linked FRNs. We provide additional tests of the price volatility in Table IA.9, highlighting that the lower price volatility of SOFR-linked FRNs is robust to controlling for issuer fixed effects and the time-to-maturity of the underlying FRNs.

To understand how this price stability affects the yield spreads of FRNs, it is critical to understand who the main investors in SOFR-linked FRNs are. As discussed by, among others, Fabozzi and Mann (2000) and Fleckenstein and Longstaff (2020), MMFs aim to minimize their asset volatility and therefore value assets with stable mark-to-market values. To examine if MMFs play an important role in our setting, we obtain monthly MMF portfolio holdings at the security level from Crane Data, which collects this information from SEC N-MFP filings. We then match the monthly outstanding notional for each FRN with the MMF holdings and calculate the aggregate percentage of LIBOR-linked and SOFR-linked FRNs held by MMFs. Panel (b) of Fig. 2 shows these fractions over time. As we can see from the figure, MMFs hold a substantial fraction of both the LIBOR-linked and SOFR-linked FRNs outstanding. SOFR-linked FRNs are more popular among MMFs which hold around 70% of the outstanding notional. Moreover, MMF's holdings of LIBOR-linked FRNs dropped substantially once SOFR-linked FRNs became widely available, suggesting MMFs prefer SOFR-linked FRNs over LIBOR-linked FRNs.

This preference can be related to the fact that even a small drop in the mark-to-market value of a MMF's assets can pose a problem for the fund. Two types of MMFs invest in FRNs. First, Government MMFs are restricted to investing in securities backed by the US Treasury, such as FRNs issued by US GSEs. The shares of Government MMFs have a stable net-asset-value of 100%, but if the net-asset-value drops below 99.5%, the MMF "breaks the buck" and investors can no longer redeem their

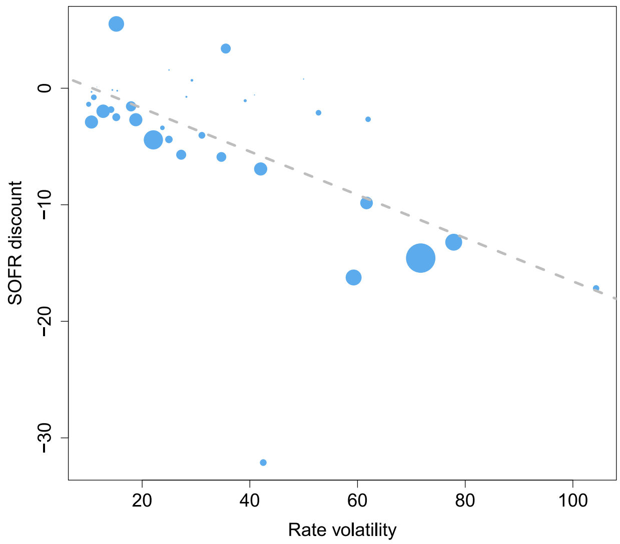


Fig. 3. Link between SOFR discount and rate volatility. This figure illustrates the link between the SOFR discount and interest rate volatility. The SOFR discount is calculated every month by running the cross-sectional Regressions (5). Interest rate volatility is measured using the implied volatility of LIBOR swaptions with forward-start date in one month written on a 1-year swap contract. The size of the circles is scaled by the absolute value of the corresponding t-statistic. The dashed line illustrates the linear relationship between the monthly SOFR discount and the interest rate volatility. The slope coefficient equals −0.23 ($t = -4.35$).

money at par value. Such an event impacts the reputation of the fund manager. The second type is Prime MMFs, which can invest in short-term debt and FRNs issued by private borrowers. The net-asset-value of prime funds is not fixed at 100%. However, a drop in the net-asset value of a prime fund can trigger a run by investors (e.g., Li et al., 2021).

5.2. Price stability and the SOFR discount

We start by examining the SOFR discount over time. To motivate our analysis, we estimate a monthly proxy of the SOFR discount by running cross-sectional regressions of the following form:

$$s_{j,i,t} = \alpha_{SOFR} + \alpha_{1m} + Controls_{j,i,t} + \varepsilon_j. \tag{5}$$

As before, the dependent variable is the adjusted issuance spread of FRN j, from borrower i, issued in month t and the controls include issuer fixed effects, the time to maturity to the power of one, two, and three, as well as the issuance amount.

To link the SOFR discount to price stability, we examine if the discount is more pronounced during periods of higher interest rate volatility. In Fig. 3, we plot the monthly SOFR discount against the implied volatility of LIBOR swaptions with forward-start date in one month written on a 1-year swap contract. Throughout this analysis we lag the dependent variable by one month to ensure that the issuance date of the FRNs is after we observe the rate volatility. As we can see from the figure, the SOFR discount is larger when interest volatility is higher.[10] The size of the circles in Fig. 3 is scaled by the absolute value of the t-statistics. The figure shows that the SOFR discount exceeds −10 basis points during times of heightened interest rate volatility.

We next examine this result using panel regressions. To that end, we modify regression Eq. (3) and interact α_{SOFR} with a second indicator variable that equals one when the implied rate volatility is above its 80% quantile. Column (1) of Table 7 shows the SOFR discount increases from −3.19 basis points during normal times to −9.22 (= −3.19 − 6.03)

Table 7
Dissecting the SOFR discount for FRNs. This table shows the results of regressing the yield spreads of newly-issued FRNs on an indicator variable $SOFR$ that equals one if the benchmark rate is SOFR and zero otherwise. To dissect the effect of $SOFR$, we examine the interaction with a set of different indicators. $q^{80}(Swaption)$ is an indicator that equals one if the implied volatility of a swaption contract written on a 1-year LIBOR swap and expiring in one month. $q^{80}(MOVE)$ is an indicator that equals one if the MOVE index in month $t-1$ is above its 80% quantile and zero otherwise. $q^{80}(\sigma_{r\ 3m})$ is an indicator that equals one if the standard deviation of the 3-month rate implied from FED funds futures is above its 80% quantile and zero otherwise. $q^{80}(VIX)$ is an indicator that equals one if the VIX index in month $t-1$ is above its 80% quantile and zero otherwise. $q^{80}(MMF)$ is an indicator variable that equals one if the fraction of outstanding FRNs from issuer j at time $t-1$ held by MMFs is above the 80% quantile of issuers in month $t-1$. $q^{80}(Govt\ MMF)$ ($q^{80}(Prime\ MMF)$) is an indicator that equals one if the fraction of outstanding FRNs from issuer j at time $t-1$ held by government (prime) MMFs is above the 80% quantile of issuers in month $t-1$. In all specifications, the control variables include an indicator that equals one if the benchmark rate is the 1-month LIBOR rate, as well as the time to maturity (ttm), the squared time to maturity (ttm^2), ttm^3, and the logarithm of the issuance amount ($\log(a)$), and issuer fixed effects, all interacted with year-month fixed effects to capture unobservable changes in the effect of these controls over time. The numbers in parentheses are t-statistics based on heterogeneity-robust standard errors, clustered at the issuer and year-month level. ***, **, and * indicate significance at a 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
$SOFR$	−3.19**	−2.80**	−2.28***	−3.64***	−4.08**	−2.85**
	(−2.08)	(−2.62)	(−3.17)	(−3.00)	(−2.56)	(−2.47)
$SOFR \times q^{80}(Swaption)$	−6.03**					
	(−2.53)					
$SOFR \times q^{80}(MOVE)$		−6.34*				
		(−1.72)				
$SOFR \times q^{80}(\sigma_{r\ 3m})$			−9.39***			
			(−2.75)			
$SOFR \times q^{80}(VIX)$				−2.97		
				(−0.61)		
$SOFR \times q^{80}(MMF)$					−2.38*	
					(−1.77)	
$SOFR \times q^{80}(Govt\ MMF)$						−4.33**
						(−2.59)
$SOFR \times q^{80}(Prime\ MMF)$						−2.95
						(−0.99)
Adj. R^2	0.94	0.94	0.95	0.94	0.94	0.94
Num. obs.	7173	7173	7173	7173	7173	7173

during times of heightened rate volatility. We next repeat this analysis using two different proxies of interest rate volatility. Our first measure is a proxy of realized rate volatility. We use FED funds futures to construct a 3-month forward-looking term rate and calculated the standard deviation of this rate every month.[11] Our second proxy is the implied volatility of US Treasuries as measured by the Merrill Lynch Option Volatility Estimate (MOVE) index. Columns (2) and (3) of Table 7 show a qualitatively similar pattern using these proxies of rate volatility. For both proxies, the SOFR discount is significantly larger during times of heightened interest rate volatility. To distinguish the role of interest rate volatility from general market uncertainty, we repeat our analysis using the implied volatility of S&P 500 as proxied by the VIX index. Column (4) of Table 7 shows the SOFR discount is not significantly larger during periods of heightened stock market uncertainty.

To conclude our analysis of price stability, we explore the role of MMFs. For each issuer, we calculate the fraction of outstanding SOFR-linked FRNs held by MMFs. Every month, we then introduce an indicator variable that equals one if the fraction of SOFR-linked FRNs

[10] We test the link between SOFR discount and rate volatility observed in Fig. 3 formally in Table IA.13 in the Internet Appendix.

[11] To construct the 3-month forward-looking rate, we use generic FED funds futures quotes from the Bloomberg system for contracts maturing in month $t+1$, $t+2$, and $t+3$. We then calculate the implied forward rate f_{t+i} as the difference between 100 and the value of the futures contract. The implied 3-month forward rate is the obtained using the following formula:

$$f_t^{3m} = \left[\left(1 + f_{t+1}\frac{30}{360}\right)\cdot\left(1 + f_{t+2}\frac{30}{360}\right)\cdot\left(1 + f_{t+3}\frac{30}{360}\right) - 1\right]\frac{360}{90}.$$

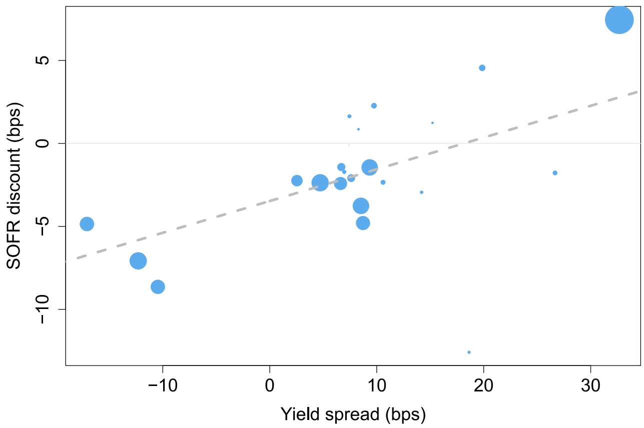


Fig. 4. FRN spreads across issuers. This figure illustrates the link between the SOFR discount and the credit spreads of the issuers. The y-axis shows the estimated SOFR discount. The estimate is based Eq. (3), allowing for different coefficients across issuers with more than one year-month during which the issuer places both LIBOR- and SOFR-linked debt. The x-axis shows the average yield spread each of the issuers. The size of the circles is scaled by the absolute value of the corresponding t-statistic. The dashed line illustrates the linear relationship between the issuers' SOFR discount and the yield spread. The slope coefficient equals 0.19 ($t = 2.43$).

held by MMFs is above the 80% quantile in that month. For issuers with a substantial fraction of MMF investors, we expect a stronger SOFR discount because MMFs are arguably the investors that are most concerned about price stability. In line with this view, Column (5) of Table 7 shows the SOFR discount is significantly larger for issuers with a substantial share of MMF investors. Going further with this analysis, we distinguish government MMFs and prime MMFs. Government MMFs have a constant net asset value and therefore a significant demand for price stability. As shown in Column (6) the SOFR discount is significantly more pronounced for FRNs with a large share of government MMF investors. The pattern is weaker but qualitatively similar for prime MMFs.

5.3. The SOFR discount across issuers

We now examine how the SOFR discount varies across issuers. To that end, we modify our regression analysis from Section 4, allowing α_{SOFR} to vary across issuers with more than one year-month of issuing both LIBOR-linked and SOFR-linked FRNs. Because the additional price stability is most valuable for safe issuers, we expect a stronger SOFR discount for borrowers with lower issuance spreads. To examine this hypothesis, we plot the estimated SOFR discounts against the average issuance spreads for the borrowers in our sample.

Fig. 4 shows the resulting estimates and we scale the size of the circles with the absolute value of the corresponding t-statistics. The figure confirms that the SOFR discount is more pronounced for borrowers with lower issuance spreads. Hence, safer issuers benefit more from transitioning to SOFR-linked FRNs. The three bottom-left circles correspond to three US GSEs (FHLBs, Fed Farm, and Farmer Mac). In addition to being among the safest borrowers in our sample, the demand from both prime and government MMFs plausibly amplifies the SOFR discount for those issuers. This cross-sectional variation in the SOFR discount also alleviates the concern that our results are driven by a mispricing in derivatives markets.

5.4. Interest rate volatility and secondary market prices

We now test our explanation for the SOFR discount on the secondary market data. Due to the smaller cross-section of issuers for secondary market quotes, we focus this part of our analysis on the SOFR discount

Table 8
Dissecting the SOFR discount in secondary markets. This table shows the results of regressing the adjusted discount margin of our FRNs in our sample on an indicator variable $SOFR$ that equals one if the benchmark rate is SOFR and zero otherwise. To dissect the effect of $SOFR$, we examine the interaction with a set of different indicators. $q^{80}(Swaption)$ is an indicator that equals one if the implied volatility of a swaption contract written on a 1-year LIBOR swap and expiring in one month. $q^{80}(\sigma_{r\ 3m})$ is an indicator that equals one if the standard deviation of the 3-month rate implied from FED funds futures is above its 80% quantile and zero otherwise. $q^{80}(MOVE)$ is an indicator that equals one if the MOVE index in month $t-1$ is above its 80% quantile and zero otherwise. $q^{80}(VIX)$ is an indicator that equals one if the VIX index in month $t-1$ is above its 80% quantile and zero otherwise. In all specifications, the control variables include the time to maturity (ttm), the squared time to maturity (ttm^2), ttm^3, and the logarithm of the issuance amount ($\log(a)$), and issuer fixed effects, all interacted with year-month fixed effects to capture unobservable changes in the effect of these controls over time. The numbers in parentheses are t-statistics based on heterogeneity-robust standard errors, clustered at the issuer and date level. ***, **, and * indicate significance at a 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)	(4)
$SOFR$	−8.03**	−8.14**	−10.29**	−11.34***
	(−2.55)	(−2.56)	(−2.68)	(−2.86)
$SOFR \times q^{80}(Swaption)$	−18.06**			
	(−2.26)			
$SOFR \times q^{80}(MOVE)$		−12.30*		
		(−1.75)		
$SOFR \times q^{80}(\sigma_{r\ 3m})$			−0.18	
			(−0.04)	
$SOFR \times q^{80}(VIX)$				5.92
				(1.33)
Adj. R^2	0.95	0.95	0.95	0.95
Num. obs.	88,922	88,922	88,922	88,922

over time. We repeat the analysis from Columns (1) to (4) of Table 7 for the secondary market data.

As shown in Table 8, a qualitatively similar pattern emerges. The SOFR discount is more pronounced during times of heightened interest rate volatility, as measured by the implied volatility from swaption contracts. Figure IA.5 in the Internet Appendix further illustrates the negative link between the SOFR discount and the swaption volatility. Columns (2) and (3) suggest that the SOFR discount is more pronounced with heightened interest rate volatility as measured by the MOVE index or the realized volatility of FED funds futures. In contrast to our results for the primary market, the difference is not statistically significant when considering elevated rate volatility proxied by FED funds futures. However, similar to our analysis for primary markets, heightened market volatility as proxied by the VIX index does not affect the SOFR discount.

6. Legal risks with the LIBOR cessation

In this section, we examine how legal risks around the LIBOR-SOFR transition affect our results. First, we investigate if the SOFR discount is driven by FRN issuances that mature after the LIBOR cessation date and therefore expose investors to legal risks. Second, we use November 30, 2020 as an exogenous shock to examine how legal concerns affected the pricing.

6.1. Maturity structure

To test if our results are driven by legal concerns about the LIBOR funeral, we define an indicator variable $\mathbb{1}_{Mat.post}$ that equals one if the maturity of a given FRN is after the LIBOR cessation date. The original cessation date, December 2021, was postponed to June 2023 in November 2020. To capture potential legal risks from the perspective of investors at the time of issuance, we introduce an indicator $\mathbb{1}_{Mat.post}$ that, for FRNs issued before November 2020, equals one if the maturity date is after December 2021 and to zero otherwise. For FRNs issued after November 2020, $\mathbb{1}_{Mat.post}$ equals one if the maturity date is after June 2023 and to zero otherwise.

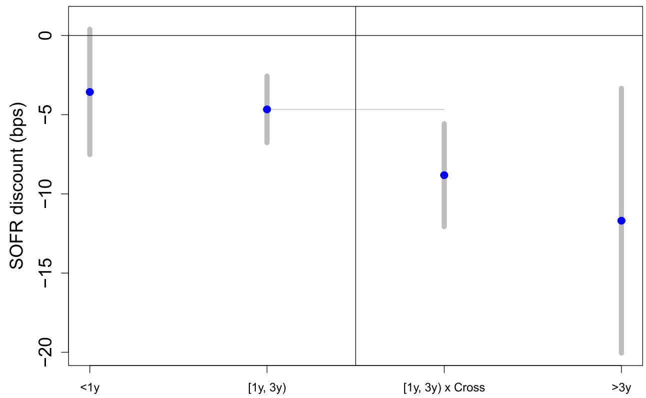


Fig. 5. FRN spreads across maturities. This figure illustrates the SOFR discount for different maturities of FRNs. $< 1y$ captures all FRNs with less than one year to maturity and $\geq 3y$ captures all FRNs with more than three years to maturity. For FRNs with maturities between one and three years, we separate two cases. "no cross" captures all FRNs that mature before the LIBOR cessation date (which, until November 2020, was December 2021 and June 2023 afterwards) and "cross" captures all FRNs that mature after the LIBOR cessation date. The grey bars are 95% confidence bars, based on robust standard errors, clustered at the issuer level.

We then modify our regression specification from Eq. (3) by interacting α_{SOFR} with the constructed indicator variable. To isolate the role of legal risks, we separately study α_{SOFR} for FRNs in the three different maturity buckets. We split the sample into securities with less than one year to maturity (which never cross the cessation date in our sample), securities with more than three years to maturity (which always cross the cessation date in our sample), and securities with maturities between one and three years, separating those that mature after the cessation date from the rest.

Fig. 5 illustrates the coefficients for the four different categories. As we can see from the figure, the role of α_{SOFR} increases for FRNs crossing the cessation date. Specifically, even for FRNs with comparable maturities, α_{SOFR} is significantly more negative for FRNs that cross the cessation date. However, the figure also reveals that legal risks cannot be the only explanation because FRNs maturing before the cessation date are also subject to a significant discount. We provide additional regression estimates with $\mathbb{1}_{Mat.Post}$ in Table IA.10 in the Internet Appendix. In addition, we examine the link between the SOFR discount and time-to-maturity in the Internet Appendix (Table IA.2), confirming that the SOFR discount increases with longer times to maturity.

6.2. Pricing effects of the LIBOR reprieve

We conclude our examination of the legal risks associated with the LIBOR-SOFR transition with a simple difference-in-differences analysis. To that end, we use the LIBOR reprieve announcement of November 30, 2020 when regulators postponed the USD LIBOR cessation from December 2021 to June 2023. The LIBOR reprieve announcement ensured that the 3-month LIBOR rate is published until July 2023 and therefore eliminated any legal risks for FRNs referencing LIBOR during this period. Hence, we would expect the price of LIBOR-linked FRNs with maturities between April 1, 2022 and September 30, 2023 (i.e., referencing 3-month LIBOR between January 1, 2022 and June 30, 2023) to increase after the announcement.

To test this hypothesis, we compare price changes for *treated* FRNs – LIBOR-linked FRNs that mature between April 1, 2022 and September 30, 2023 – to price changes of other FRNs around the reprieve announcement. Specifically, we introduce an indicator variable that equals one if the date is November 30 or December 1, allowing one day for the information to settle into prices. We then compare price changes of the affected FRNs on the event date to price changes of other FRNs, focusing on the two-month period around the reprieve announcement (November 1, 2020 to December 31, 2020). As basic control variables we include security (CUSIP-level) and time fixed effects in all specifications.[12] We also investigate how controlling for both the level and the change in bid–ask spreads affects the results. Table 9 shows the results of our estimation. As we can see from the table, there is statistically significant increase in the prices of affected FRNs around the LIBOR reprieve announcement. However, the economic significance of the price increase is small and around one basis point.

Table 9
Effect of the LIBOR reprieve. This table shows the results of examining percentage changes in FRN prices around the LIBOR reprieve announcement on November 30, 2020. Treated are all FRNs that reference LIBOR and mature between January 1, 2022 and September 30, 2023 (because September 30 is the last date for which 3-month LIBOR was available). *Event* is an indicator that equals one on November 30, 2020 and December 1, 2020. The sample period is November 1, 2020 to December 31, 2020, comprising all FRNs with secondary market prices. The numbers in parentheses are t-statistics based on heterogeneity-robust standard errors, clustered at the CUSIP level. ***, **, and * indicate significance at a 1%, 5%, and 10% level respectively.

	(1)	(2)
$Treated \times Event$	0.0114**	0.0114**
	(2.2507)	(2.2526)
$BidAsk$		0.0129
		(0.3548)
$\Delta BidAsk$		0.1096
		(1.1878)
CUSIP FE	✓	✓
Date FE	✓	✓
Adj. R^2	0.0785	0.0797
Num. obs.	5489	5489

7. Conclusion

The central concern about the LIBOR-SOFR transition is that investors in floating-rate debt lose the hedging benefits inherent in LIBOR-linked debt. This loss of hedging benefits could make investments in floating-rate debt linked to SOFR less attractive and increase the cost of borrowing floating-rate debt. Motivated by these arguments, we investigate if SOFR-linked debt costs borrowers more than LIBOR-linked debt. Focusing on the primary market for FRNs, our results answer this question with a clear no. After adjusting for the differences in variable rates, SOFR-linked FRNs cost borrowers *less* than LIBOR-linked FRNs. The estimated SOFR discount is around −5 basis points and increases to around −10 basis points during times of heightened interest rate volatility. We link this discount to the additional price stability of FRNs linked to an overnight rate instead of a term rate. This discount associated with borrowing floating-rate debt linked to an overnight rate has important policy implications for other jurisdictions such as the Euro-area and Japan, where debt markets might transition from term rates to overnight rates in the future.

Based on our proxy for the SOFR discount, we estimate US GSEs saved $330 million in interest expenses. Because our results are based on FRNs, where MMFs are the predominant investor, they do not contradict the arguments discussed by Jermann (2019) and Cooperman et al. (2022)—it is still plausible that the benchmark transition has an adverse effect on loan supply. However, quantifying this effect is an empirical challenge and our paper is the first to empirically examine the link between the borrowing cost for floating-rate debt and the reference rate of the debt.

[12] Any effects of the remaining time-to-maturity are absorbed by this combination of fixed effects.

CRediT authorship contribution statement

Sven Klingler: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Olav Syrstad:** Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors hereby declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this article.

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