SHEDDING LIGHT ON THE DYNAMICS OFTHE SECURED OVERNIGHT FINANCING RATE (SOFR)

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Abstract - Motivated by the transition from LIBOR to SOFR and the documented volatility of SOFR, we examine the drivers of the SOFR rateby investigating both the SOFR–EFFR and SOFR–IOER spreads. We find that end-of-monthanomalies and Federal Reserve market interventions have a strong impact onthe SOFR rate. Investors in SOFR-linked instruments should be aware of Federal Reserve interventions.

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I. INTRODUCTION

In light of the transition from LIBOR to the Secured Overnight Financing Rate (SOFR),one of the major financial reforms in the past century, the driversof the SOFR rate are studied in this paper. Although SOFR is based on repo rates, a metric that is not new to participants in the financial market, the calculation itself is new and has been published officially only since 2018. Therefore, this paper joins a limited number of studies that investigate the drivers of the SOFR rate. The contribution of this work is reinforcedby the recent rise in the volatility of the SOFR Effective Federal Fund Rate (EFFR)compared to other benchmark rates.

Usingtime-series analysis with both daily and weekly data, we discover two key drivers that affect the SOFR–EFFR spread (and the SOFR–IOER spread as well). The first is end-of-month, at which the spread tends to spike. This effect corresponds to periods of cash shortages and balance-sheet constraints and is discussed by Klingler and Syrstand (2021) andAnbil et al. (2021).The second is the impact of Federal Reserve interventions. To date, most studies concentrate mainly on the Fed's balance sheet. However, we examine the impact of two additional drivers: policy changes with regard to the interest on excess-reserves rate and net repo/reverse-repo activity.

The rest of the paper is organized as follows. Section 2 reviews the related literature. Section 3 details the data and provides descriptive statistics. Section 4 presents the empirical analysis. Section 5 concludes.

II. LITERATURE REVIEW

In mid-September 2019, SOFR jumped surprisingly by about 280 basis points, from 2.43% to 5.25%, and the 90-day average increased by about 5 basis points the same day. The effect of a 5-basis-point change in the interest rate on trillions of dollars in assets was enormous. Moreover, because of the averaging method, the distortion had a counter-effect (a decrease of 5 basis points) on Day 91. The reasons for the unusual spike in SOFR rates in September 2019 are debated.Several authors argue that this unexpected upturn was a perfect storm unleashed by a liquidity crunch in which the supply of cash available for lending contracted while demand for cash increased, as described in detail by Afonso et al. (2020), Anbil et al. (2020), Ihrig et al. (2020), and Correaet al.(2020).

Several studies have shown that calendar end dates affect the prices of financial assets.Du et al. (2018) documents end-of-quarter effects on deviations from covered interest rate parity (CIP). A large and growing literature focuses on the limits of arbitrage between Treasury repo rates and the interest on excess reserves (IOER) rate. Han (2020) attributes the upward regime shift in the spreads between the IOER and the overnight funding rate to the segmentation of U.S. money markets in the repo market. Yang (2020) states that intraday payment delays cause repo rates to spurt.Correa, Du and Liao (2020) analyze the way daily changes in repo-rate spreads respond to daily changes in the Treasury's general-account balances and daily changes in the Federal Reserve's holdings of Treasuries and Agencies in its System Open Market Account. Pozsar (2019) argues that Treasury issuances increase repo rates along the intraday payment timing channel. Duffie and Krishnamurthy (2016) pointto frictions associated with imperfect competition and regulation.

III. DATA AND DESCRIPTIVE STATISTICS

We used data from Bloomberg, the Federal Reserve Bank of New York, and Federal Reserve Economic Data (FRED) for April 2018–June 2021. Some of the explanatory variables are published on a daily basis;

others appear weekly. Hence, we ran two sets of regressions, one using daily data and one using weekly data. The dependent variable in the main regressions is the spread between SOFR and EFFR. Both rates proxy for the one-day risk-free rate; therefore, any gap between them indicates friction. However, the EFFR itself may also be affected by market frictions and institutional factors. The EFFR lies persistently below the interest on excess reserves(IOER) rate because not all Fed fund participants earn the IOER.As a result, the cash position of government-sponsored enterprises affects the difference between the EFFR and IOER. In addition, an abnormally low EFFR rate is also correlated with reverse repo borrowing by the Fed because institutions like the Federal Home Loan Banks are very active lenders in both markets. Therefore, when the EFFR rate is low, it becomes more attractive to park funds in the Fed's reverse-repo facility. Hence, for a robustness check, we considered a seconddependent variable, estimated as the SOFR–IOER spread between the SOFR and IOER. In this specification, we also added the spread between the IOER and EFFR as an independent variable.

IV. EMPIRICAL ANALYSIS

4.1 Regressions with Daily Data

We performed a time-series analysis[1]using the Dynamic Ordinary Least Squares (DOLS) method (Stock &Watson 1993) to determine whether our selected explanatory variables are significant in explaining the main dependent variable,the SOFR–EFFR spread[4]. We adjusted the serial correlations in errors using Newey and West's (1987) method:

$$(1)\quad \mathrm{SOFREFFR}_t = \alpha_0 + \beta_1 \mathrm{VSOFR}_t + \beta_2 \mathrm{VIX}_t + \beta_3 \mathrm{NET}_t + \beta_4 \mathrm{IOEREFFR}_t + \beta_5 \mathrm{RRP}_t + \beta_6 \mathrm{EMO}_t + \sum_{j=-K}^{K} \varphi_{1j} \Delta \mathrm{VSOFR}_{t-j} + \sum_{j=-K}^{K} \varphi_{2j} \Delta \mathrm{VIX}_{t-j} + \sum_{j=-K}^{K} \varphi_{3j} \Delta \mathrm{NET}_{t-j} + + \sum_{j=-K}^{K} \varphi_{4j} \Delta \mathrm{IOEREFFR}_{t-j} + \sum_{j=-K}^{K} \varphi_{5j} \Delta \mathrm{RRP}_{t-j} + \varepsilon_t^i$$

where α_0 is the drift component and Δ is the first difference operator. K is the lag length, SOFREFFR is the spread between the SOFR rate and the EFFR rate at time t, VSOFR is the volume of SOFR transactions, VIX is the volatility in the S&P500 index, NET is the net short-term repo and reverse-repo agreements conducted by the Federal Reserve, IOEREFFR is the spread between the IOER rate and the EFFR rate, RRP is the Overnight Reverse Repurchase Agreement Facility rate and the EFFR rate, and EMO is a dummy variable that receives the value of 1 at the end of a month and 0 otherwise.

As Table 3 shows, the coefficients of NET and RRP are statistically significant at the 1% level, indicating that Federal Reserve market interventionsaffect the SOFR rate spread. The coefficient of EMO is statistically significant at the 1% level with a positive sign in both models, indicating that month-end anomalies cause the SOFR–EFFR spread to widen. The results are also robust for the secondary dependent variable, the SOFR–IOER spread.

	SOFR–EFFR spread	SOFR–IOER spread
VSOFR	0.1650**	0.224**
	(0.0656)	(0.0887)
VIX	0.0002	-0.0007
	(0.0007)	(0.0010)
NET	0.0001**	0.0001***
	(0.0004)	(0.0004)
IOEREFFR	0.5230	//
	(0.3940)	//
RRP	0.0325***	0.0306***
	(0.0065)	(0.0061)
EMO	0.0629***	0.0674***
	(0.0196)	(0.0202)
Constant	-0.1950***	-0.2380***
	(0.0588)	(0.0664)
N.	781	781
Adj. R-sq.	0.134	0.151

Table 3. Daily regressions. This table reports the means and standard deviations (in brackets). The main dependent variable is the SOFR–EFFR spread.For robustness, we also estimated the SOFR–IOER spread. The sample period is April 2018-June 2021. * indicates significance at the 1% level and ** indicates significance at the 5% level.**

4.2. Regressions with Weekly Data

Next, we asked whether the intervention of the Federal Reserve in the open market by purchasing Treasuries also affects the SOFR spread. For this purpose, we estimated the change in the face value of U.S. Treasury securities held by the Federal Reserve. As a control variable, we calculated the change in the net Treasury positions of primary dealers. On this

basis, we estimated a weekly time-series regression using the Dynamic Ordinary Least Squares (DOLS) method (as in Stock &Watson 1993).

Table 4 shows that in both models the coefficients of FED[5] are statistically significant at the 1% level with a positive sign. The positive sign indicates that the Federal Reserve's intervention causes the SOFR–EFFR spread to widen. There are two explanations for this result. First, purchases of U.S. Treasury securities by the Federal Reserve reduce the supply of high-quality collateral and therefore increase demand for the repo transactions with which this collateral is obtained. Consequentially,the increase in demand for repo transactions increases the SOFR rates. Second, these purchases raise the level of reserves in the banking system by increasing the banks' balance sheets, therefore reducing their capacity to execute repo transactions. The decrease in the supply of repo transactions also causes SOFR rates to rise.

	SOFR–EFFR spread	**SOFR–IOER spread**
FED	0.00002***	0.00003***
	(0.00004)	(0.00008)
Primary dealers	-0.00020	-0.00092
	(0.00051)	(0.00067)
Constant	0.07390***	0.10400***
	(0.01750)	(0.03470)
N.	158	158
Adj. R-sq.	0.122	0.186

Table 4. Weekly regressions. This table reports the means and standard deviations (in brackets). The main dependent variable is the SOFR–EFFR spread.For robustness, we also estimated the SOFR–IOER spread. The sample period is April 2018-June 2021. * indicates significance at the 1% level and ** indicates significance at the 5% level.**

V. CONCLUSION

For more than half of the century, LIBOR was the reference rate for multiple financial instruments such as bonds, loans, mortgages, and derivatives. The transition from LIBOR to SOFR is one of the most important and complicated financial reforms in recent history. In September 2019 and March 2020, we saw extensive volatility in the SOFR rate. Given the major role that this reference rate will play in the near future, it is important to identify the factors that promote such volatility and investigate methods that may dampen it.

Our papershows thatend-of-monthanomalies and theFederal Reserve'sintervention in open-market operations have a strong impact onthe SOFR rate. This issue may become much more severe once the Federal Reserve starts unwinding its quantitative-easing program. To mitigate the distortion, it is reasonable to exclude the end-of-month rates when calculating the SOFR. In addition, to prevent market dislocation during periods of stress in which the supply of cash available for lending declines while demand for cash increases, it may be beneficial for the Fed to incentivize banks to use the discount window by temporarily lowering the discount-window rate for a short and predefined period.

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