US Rates Viewpoint

SOFR/FF basis: biased wider

Recent bill wave offers SOFR lessons learned

UST unleashed a bill supply wave to start '23. YTD thru Mar 7 UST will issue $395b bills, the vast majority since mid-Jan. This cheapened 1 & 3m bills vs OIS by 70 & 15bps YTD.

The bill supply wave had surprisingly little impact on levels of overnight repo. SOFR & TGCR have remained very stable amidst the supply surge. Stability of O/N repo surprised us amidst other front-end cheapening & reflects abundant levels of short-dated cash.

Repo stability amidst the recent bill supply surge has shifted our thinking on the near- & medium-term outlook for SOFR & SOFR/FF basis (FF-SOFR). Thoughts on each:

Near term (next 3m): SOFR is likely biased lower & the SOFR/FF basis wider with upcoming bill supply cuts, short duration inflows, & risk of higher specials activity if Fed terminal keeps re-pricing higher. March SOFR settings could again fall below ON RRP. We are doubtful recent soft EFFR prints are likely to persist.

Medium term (6-12m): SOFR will face upward pressure after the debt limit is resolved with a large $850-950bn bill supply wave. However, we think SOFR/FF basis may be overstating the extent of the rise. SOFR/FF unlikely to meaningfully narrow by late '23.

SOFR/FF forecasting: no long arc, 2 SOFR regimes

SOFR stability amidst the recent bill supply wave has also shifted our thinking on the likely trajectory of SOFR/FF with Fed QT. We no longer expect QT to place slow & gradual upward pressure on SOFR & FF, slowly narrowing the SOFR/FF basis. We now expect SOFR/FF to evolve in 2 discrete regimes: with large ON RRP balances & without.

Large ON RRP balances ($500b+): will allow for limited upward pressure on SOFR & tri-party repo. Tri-party repo is unlikely to rise meaningfully above ON RRP with elevated ON RRP balances, since MMF should move cash out of the Fed for ON RRP +1bp. SOFR will be anchored by tri-party repo; SOFR to tri-party spread may be limited to 4-5bps.

As SOFR is anchored by tri-party repo & ON RRP, there will be greater scope for fed funds to rise vs SOFR. We have been struck by the pronounced upward pull in the FF 99th percentile & see potential for this to extend across parts of the FF distribution in time.

Low ON RRP use (<$500b): once ON RRP balances fall closer to zero we see scope for more rapid SOFR/FF tightening, led by higher SOFR rates. We are unsure exactly when this inflection point occurs but we assume it is after ON RRP balances fall below $500b. Our most aggressive ON RRP decline assumptions don't see this until 2H '24.

Bottom line: near-term SOFR is biased lower with bill cuts; this should lean SOFR/FF wider. Medium-term SOFR will likely be pulled higher with bill supply post debt limit; we think the market may be overestimating how quickly SOFR reaches or exceeds FF. SOFR is unlikely to reach FF until ON RRP is sufficiently depleted.

Refer to important disclosures on page 10 to 11.
12526289
Timestamp: 03 March 2023 06:00AM EST

03 March 2023
Rates Research
United States

Mark Cabana, CFA
Rates Strategist
BofAS
+1 646 855 9591
mark.cabana@bofa.com

Katie Craig
Rates Strategist
BofAS
+1 646 855 6625
katie.craig@bofa.com

YTD: year to date

OIS: overnight index swap

SOFR: secured overnight financing rate

O/N: overnight

TGCR: tri-party general collateral rate

FF: federal funds

EFFR: effective federal funds rate

QT: quantitative tightening

EM: extraordinary measures

UST: US Treasury

ON RRP: overnight reverse repurchase facility

SOFR/FF basis = EFFR – SOFR

SOFR/FF too excited, too soon

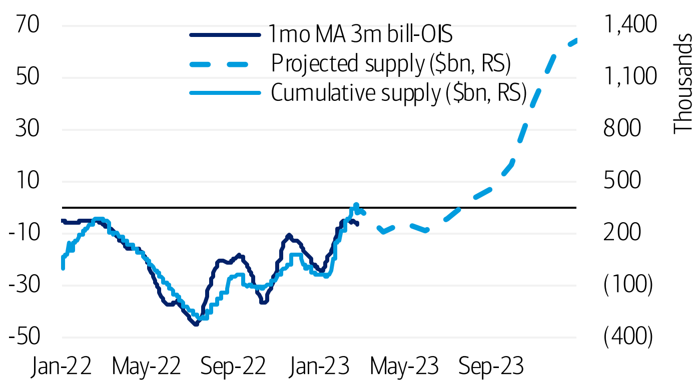
Our front-end year ahead in early Nov '22 flagged the $1tn UST bill surge in '23. We argued this supply surge would tighten SOFR/FF basis materially & recommended clients consider 1y1y SOFR/FF tighteners (see: US front end in '23). The market moved quickly with the view, faster than we thought. We now think the market may have gone too far.

We still fully believe in the supply story & the market impact. We just think the market is pricing too much of this impact too soon. We don't think SOFR/FF will be negative or flat by end '23, but pressure will be in that direction.

Early supply surge: lessons learned

The '23 supply story has evolved as expected. We thought UST would tap extraordinary measures (EM) early in '23, releasing a mini bill surge in Q1. UST delivered. By March 7, UST will have issued $395b in new bills YTD, exhausting nearly all EM (Exhibit 1).

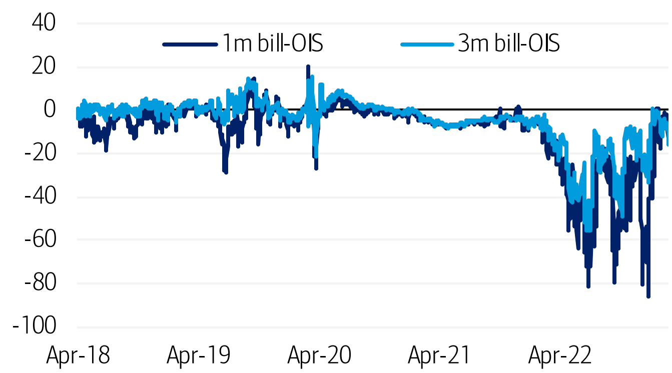
Exhibit 1: Cumulative & projected bill supply with 3m bill OIS 1mo MA
1month moving avg of 3m bill OIS tracks cumulative bill supply closely



Source: BofA Global Research, Bloomberg

BofA GLOBAL RESEARCH

Exhibit 2: 1m and 3m bill to OIS (bps)
Bills have cheapened (spread to OIS became less negative) recently due to higher bill supply



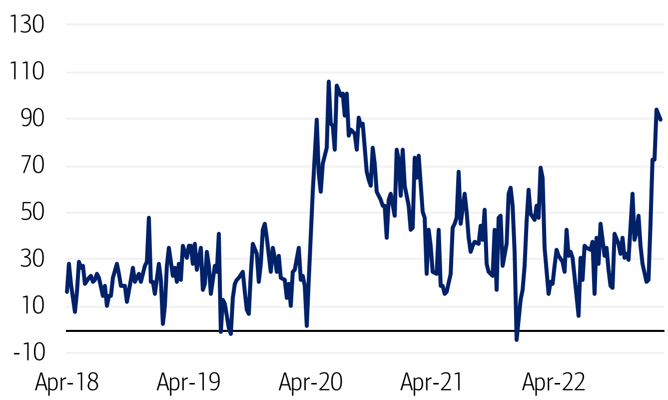
Source: BofA Global Research, Bloomberg

BofA GLOBAL RESEARCH

This supply surge will likely end soon with projected bill cuts in March. However, in the surge, we learned a few things, both expected & unexpected:

Expected: 1 & 3m bills to OIS cheapened notably, dealer bill holdings increased, SOFR volumes increased (dealer holdings need to be financed in repo) (Exhibit 2, Exhibit 3, Exhibit 4). ON RRP use also declined with supply & cheaper levels (Exhibit 5).

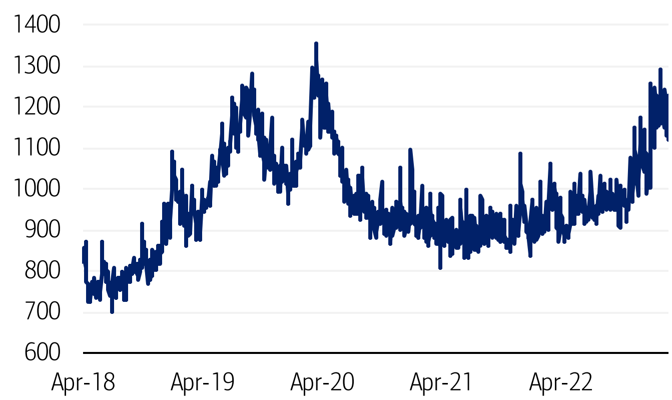
Exhibit 3: Primary dealer bill holdings ($bn)
PD bill holdings have risen with the increase in bill supply in Jan and Feb



Source: BofA Global Research, FRBNY, Bloomberg

BofA GLOBAL RESEARCH

Exhibit 4: SOFR volumes ($bn)
SOFR volumes rise with higher dealer bill holdings



Source: BofA Global Research, FRBNY, Bloomberg

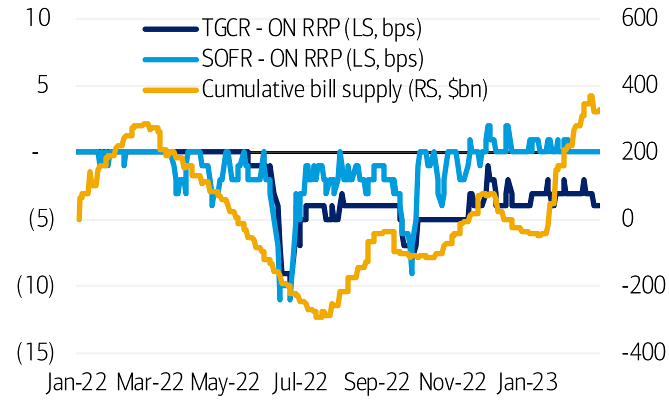
BofA GLOBAL RESEARCH

Exhibit 5: ON RRP take-up ($bn)
ON RRP take-up typically declines when bills cheapen

Source: BofA Global Research, FRBNY, Bloomberg

BofA GLOBAL RESEARCH

Exhibit 6: TGCR and SOFR spreads to ON RRP vs bill supply
SOFR -ON RRP has been stable despite higher bill supply



Source: BofA Global Research, FRBNY, Bloomberg

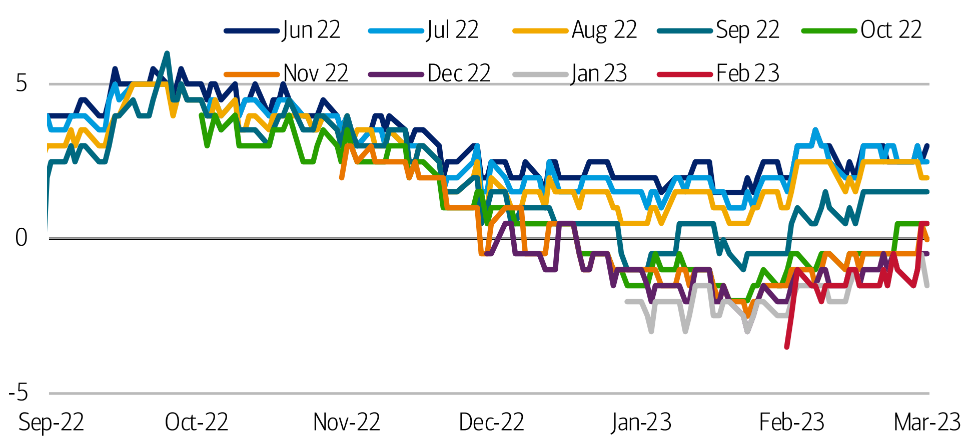
BofA GLOBAL RESEARCH

Unexpected: SOFR has been remarkably stable (both tri-party & bi-lateral) around O/N RRP (Exhibit 6). This stability is consistent through the SOFR distribution.

Our biggest takeaway is that SOFR is likely to remain well anchored around ON RRP even with higher supply. It seems there is still plenty of cash for the increased collateral.

The market seems to have learned a similar lesson on SOFR stability. Since the UST bill surge SOFR/FF contracts from Feb '22 to Aug '22 have widened 2bps (implying lower SOFR vs FF) (Exhibit 7). SOFR/FF contracts in late '22 should take note of the stability.

Exhibit 7: monthly SOFR/FF basis spreads (bps)
SOFR/FF basis has tightened, esp for contracts after expected debt limit resolution



Source: BofA Global Research, Bloomberg; note SOFR/FF basis = fed funds less SOFR

BofA GLOBAL RESEARCH

SOFR & SOFR/FF outlook: near & medium term = wider

Repo stability amidst the recent bill supply surge has shifted our thinking on the near- & medium-term outlook for SOFR & SOFR/FF basis. Thoughts on each:

Near term (next 3m): SOFR is likely biased lower & the SOFR/FF basis wider with upcoming bill supply cuts, short duration inflows, & risk of higher specials activity if Fed terminal keeps re-pricing higher. March SOFR settings could again fall below ON RRP. We are doubtful the recent soft EFFR prints are likely to persist.

Bill supply cuts

We project near-term bill supply cuts as we move closer to the X-date on the debt limit (see Bill supply swings due to debt limit dynamics). Bills will be cut as Treasury uses up extraordinary measures and as the government receives more income from taxes. Uncertainty around tax income is a risk to our bill supply forecast but as we approach the X-date it is likely Treasury will cut bills to make way for coupon issuance. With less collateral, the rate on GC repo is likely to decline, pulling SOFR down with it.

Inflows into US gov't funds

Despite the recent selloff, US government bond funds have recently seen large inflows, potentially stemming from US equity and high yield outflows (see Large US gov fund inflows). These inflows are primarily concentrated in short-duration gov't funds. Inflows into these funds will likely put downward pressure on SOFR.

Higher specials activity

If we continue to see strong employment data and inflation surprise to the upside, there are risks for the terminal rate to keep repricing higher. This will likely lead to more short selling. Short sellers will sell a borrowed security in the hopes of buying it back at a lower price. Recall, when a cusip is trading "special" it means that the repo rate for that security is below the rate on GC repo. In this event, higher specials activity would drive down the bilateral repo component of SOFR.

Medium term (6-12m): SOFR will face upward pressure after the debt limit is resolved with a large $850-950bn bill supply wave. However, we think the SOFR/FF basis may be overstating the extent of the SOFR increase. SOFR is unlikely to catch-up to FF until ON RRP is sufficiently depleted.

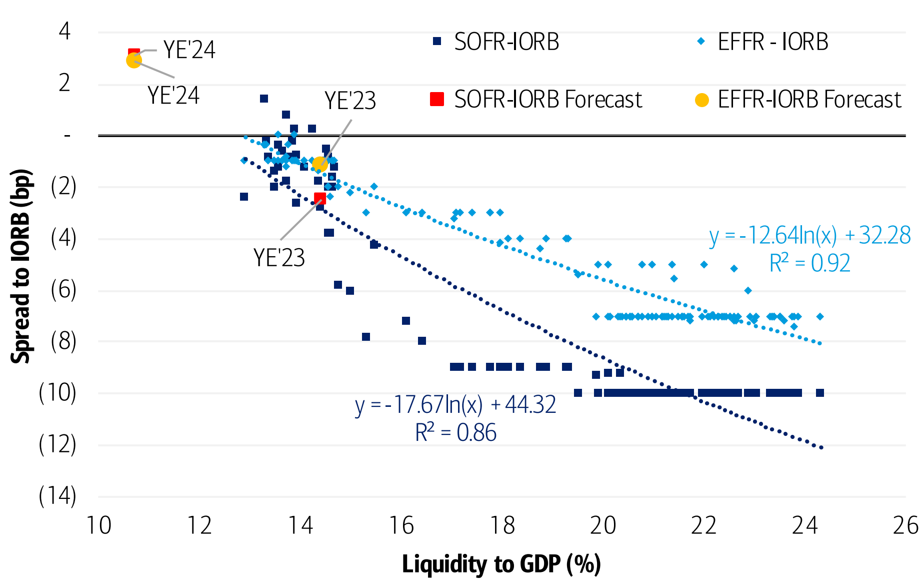
We elaborate on our medium-term views in the context of adjustments to our SOFR/FF modelling, below.

SOFR/FF modelling: 2 regimes = with & w/out ON RRP use

SOFR stability in the recent supply surge caused us to re-assess our thinking on the evolution of SOFR/FF with the QT liquidity drain. We previously modelled this process as a slow, continual arc. QT drain would put upward pressure on SOFR & FF (Exhibit 8).

Exhibit 8: SOFR & FF to IORB vs liquidity to GDP since July 2020

We previously assumed SOFR would move up faster than EFFR via QT drain



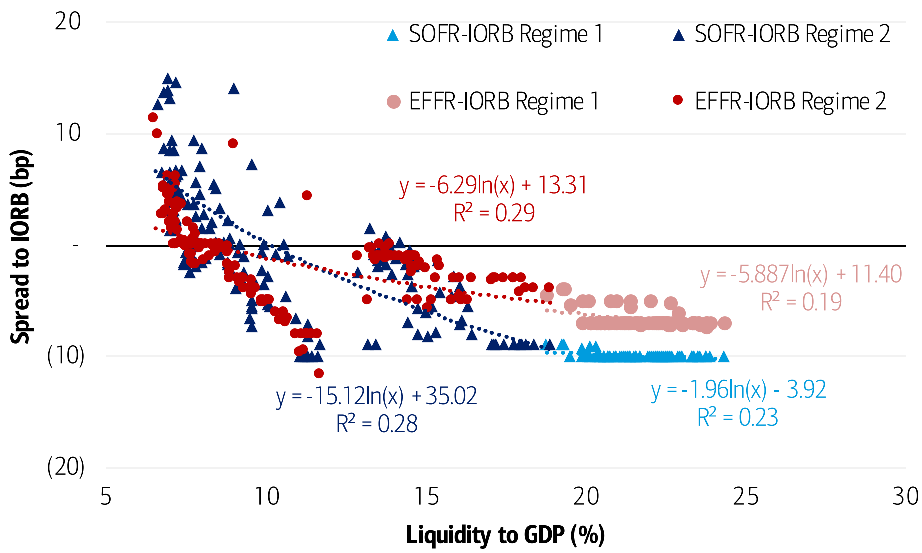
Source: BofA Global Research, FRBNY, Bloomberg. Note: for SOFR-IORB, we bind all prints below -10bp at -10bps; "liquidity" is defined as reserves + ON RRP

BofA GLOBAL RESEARCH

The recent SOFR stability shifted our thinking: it may not be a slow arc but rather a process of 2 SOFR/FF regimes (Exhibit 9). The 2 regimes = (1) with ON RRP use (2) w/out RRP use. This 2-regime approach shifts our assessment of the SOFR/FF basis, which makes the late '23 basis appear tight. We favor a SOFR/FF widening bias for a market that prices too much tightening too quickly. We elaborate on the regimes below.

Exhibit 9: SOFR & FF to IORB vs liquidity to GDP in periods of high and low ON RRP balance

Regime 1: ON RRP balance >$500bn (Jan 2018-May 2021); Regime 2: ON RRP balance <$500bn (June 2021-present)



Source: BofA Global Research, FRBNY, Bloomberg. Note: for SOFR-IORB, we bind all prints below -10bp at -10bps

BofA GLOBAL RESEARCH

Regime 1, with large ON RRP use (ON RRP >$500b): recent repo stability suggests SOFR will remain well anchored around ON RRP as use is >$500b or so. SOFR will remain stable since it will be anchored by tri-party repo (TGCR). We expect most dealers can obtain tri-party repo financing from MMF by offering rates of ON RRP+1bp. This will limit the extent to which SOFR can rise until ON RRP use is severely depleted.

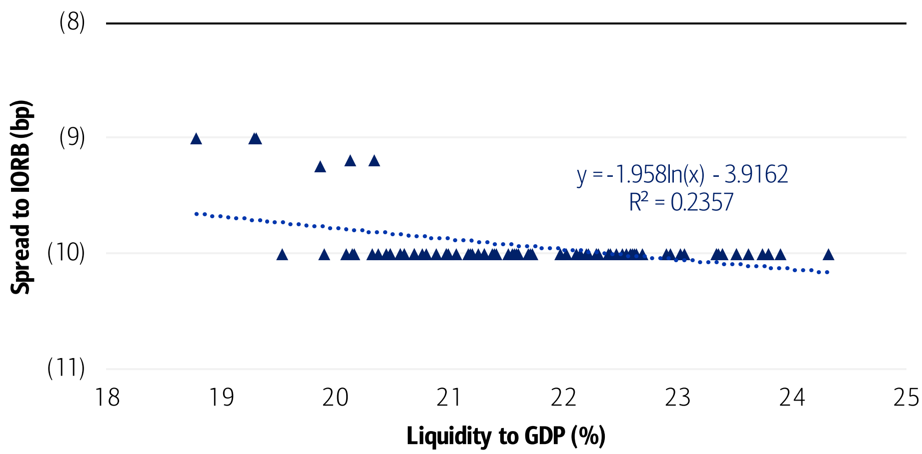
SOFR can rise modestly with tri-party repo anchored at ON RRP but its increase will be limited. Recall, SOFR is an amalgam of 3 different repo rates: (1) tri-party, MMF lends cash to dealer (2) inter-dealer, dealer lends cash to dealer (3) bi-lateral, dealer lends cash to borrower (i.e., hedge fund). SOFR can increase due to tri-party repo rising to ON RRP (Fed TGCR rate currently = 4.52%) or bi-lateral repo pulling SOFR higher.

Historically, the SOFR to tri-party spread has averaged 2.5bps using data since Aug '14. The 80th pctl of the SOFR-tri-party spread is 4bps, which we assume is a reasonable upper bound for the extent of any sustained SOFR increase. Therefore, if ON RRP balances are meaningfully positive (+$500b) we don't think SOFR can exceed tri-party repo more than 4bps. The tri-party repo component will limit how far SOFR can increase.

We expect that tri-party repo will eventually rise towards ON RRP but this will likely require a more meaningful cheapening of short-dated bills (i.e. 1m bills). Higher bill rates will be required to pull cash out of ON RRP & convince MMF that bills & repo are viable alternatives to investing with the Fed. We might guess that tri-party repo moves back to or near ON RRP by end '23 or early '24. Still, TGCR is unlikely to liftoff of ON RRP until ON RRP is sufficiently depleted.

We think that SOFR will be well contained around ON RRP as Fed liquidity withdrawal continues through end '23 & early '24. Using data going back to Q2 '21 when ON RRP balances increase we see clear evidence that any reduction in Fed liquidity (reserves + ON RRP) does not result in much upward pressure on SOFR (Exhibit 10).

Exhibit 10: SOFR to IORB vs liquidity to GDP
Period of April '21 to present. SOFR is projected to stay flat or close to ON RRP until there has been a significant drain on liquidity



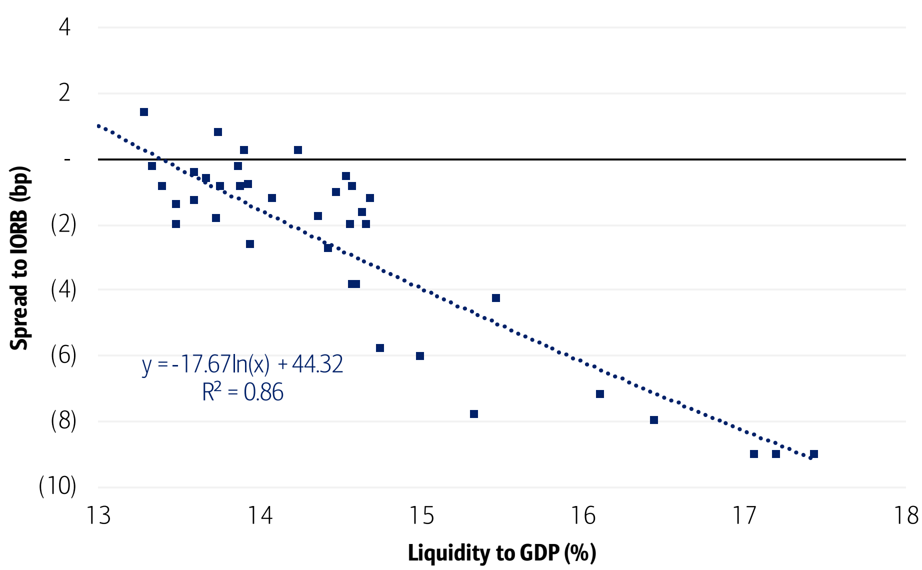
Source: BofA Global Research, FRBNY, Bloomberg; Note: for SOFR-IORB, we bind all prints below -10bp at -10bps

BofA GLOBAL RESEARCH

Regime 2, without meaningful ON RRP use: SOFR will have more meaningful potential to rise after ON RRP use drop close to zero (<$500b). Lower ON RRP utilization will reflect a depletion of cash available to back stop the tri-party repo market & allow for an un-anchoring of repo rates off ON RRP.

After ON RRP use has been depleted we expect to see much clearer upward pressure on repo rates. The period of June '20 to Mar '21 provides a relevant historical comparison to see the sensitivity of repo rates to Fed liquidity in the market (Fed liquidity = reserves + ON RRP) (Exhibit 11). We think it important to normalize Fed liquidity by GDP since reserve demand should increase with overall bank balance sheet size & nominal GDP.

Exhibit 11: SOFR to IORB vs liquidity to GDP
Period of June'20 to March 2021, SOFR was much more sensitive to Fed liquidity



Source: BofA Global Research, FRBNY, Bloomberg; Note: for SOFR-IORB, we bind all prints below -10bp at -10bps

BofA GLOBAL RESEARCH

We observe that when ON RRP is near zero there is much clearer relationship between Fed liquidity / GDP & SOFR. Draining cash from the ON RRP increasingly appears to be a pre-condition for the tri-party repo rate & SOFR to move meaningfully upwards in the Fed target range.

Overall, we believe that this 2-regime approach to understanding SOFR matters since it implies that SOFR will be relatively well anchored around ON RRP until ON RRP use is meaningfully depleted. We don't expect SOFR to meaningfully rise off ON RRP until facility utilization reaches close to zero.

SOFR/FF projections: longer period for SOFR/FF widening

We update our SOFR/FF projections using this 2-regime approach (Exhibit 12, Exhibit 13). These projections forecast SOFR to remain well anchored around ON RRP until mid to late '24 after ON RRP use is depleted, consistent with regime 1 above.

Exhibit 12: Projected SOFR and FF spreads based on model outputs of each regime

SOFR will likely rise faster once excess liquidity from ON RRP is drained

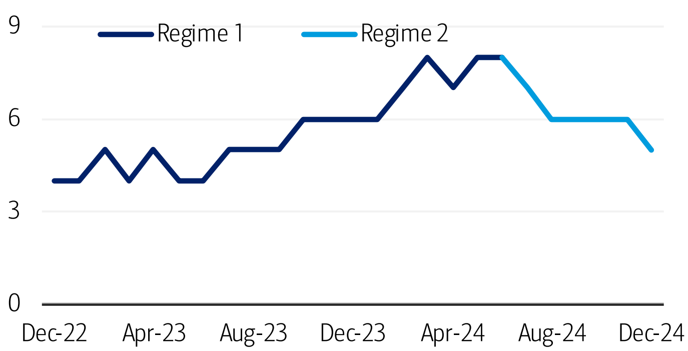
	Date	ON RRP	FF-SOFR	SOFR-IOER	EFFR-IOER
Regime 1	Dec-22	2,293	4	(10)	(6)
	Jan-23	2,062	4	(10)	(6)
	Feb-23	2,063	5	(10)	(5)
	Mar-23	2,062	4	(9)	(5)
	Apr-23	2,013	5	(10)	(5)
	May-23	2,008	4	(9)	(5)
	Jun-23	1,974	4	(9)	(5)
	Jul-23	2,058	5	(9)	(4)
	Aug-23	2,150	5	(9)	(4)
	Sep-23	1,755	5	(9)	(4)
	Oct-23	1,459	6	(9)	(3)
	Nov-23	1,266	6	(9)	(3)
	Dec-23	1,072	6	(9)	(3)
	Jan-24	982	6	(9)	(3)
	Feb-24	892	7	(9)	(2)
	Mar-24	797	8	(9)	(1)
	Apr-24	700	7	(9)	(2)
	May-24	625	8	(9)	(1)
	Jun-24	551	8	(9)	(1)
Regime 2	Jul-24	477	7	(8)	(1)
	Aug-24	402	6	(6)	-
	Sep-24	327	6	(6)	-
	Oct-24	253	6	(5)	1
	Nov-24	178	6	(4)	2
	Dec-24	120	5	(3)	2
	Dec-24	120	5	(3)	2

Source: BofA Global Research, FRBNY, Bloomberg

BofA GLOBAL RESEARCH

Exhibit 13: Projected SOFR/FF spread (bps)

SOFR projected to stay close to ON RRP while FF moves up faster, until ON RRP take-up drops below $500bn

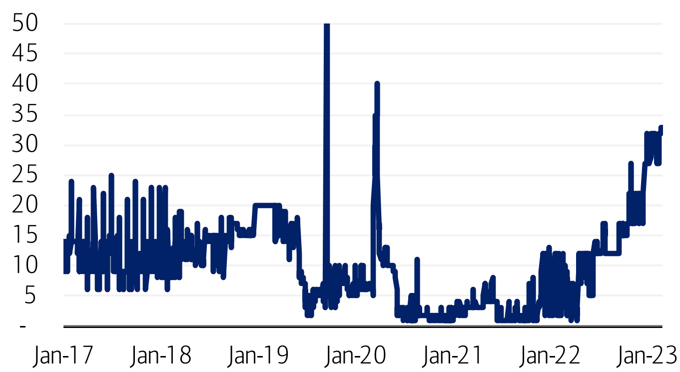


Source: BofA Global Research, FRBNY, Bloomberg

BofA GLOBAL RESEARCH

Exhibit 14: 99th percentile and EFFR historical spread (bps)

The FF 99th percentile has been climbing relative to the median recently



Source: FRBNY, Bloomberg

BofA GLOBAL RESEARCH

Our forecasts also show FF increasing vs SOFR in regime 1. This SOFR/FF widening is based on historical observations that showed a slower pace of decline in FF vs SOFR. We do not have high conviction in the FF increase vs SOFR because: (1) FF can be sticky & slow to adjust (2) EFFR has recently set lower. However, we have also observed a recent upward pull in the higher rate parts of the FF distribution, especially in the 99th percentile (Exhibit 14). We have less conviction in the path of FF as the QT liquidity drain proceeds but can see the case for EFFR to set higher while SOFR remains stuck near ON RRP.

We expect that while both SOFR and FF will face upward pressure post debt limit resolution, we expect the spread to hold steady until ON RRP has been sufficiently drained (Exhibit 15, Exhibit 16). We have low confidence in EFFR rising meaningfully vs SOFR, esp while ON RRP balances are elevated. We therefore exercise subjective judgement and assume a stable SOFR/FF spread of 3bps until 2H '24 after which ON RRP balances will likely fall low enough to see material upward pressure on SOFR. Our detailed projections are below.

Exhibit 15: Subjective SOFR and FF spread projections

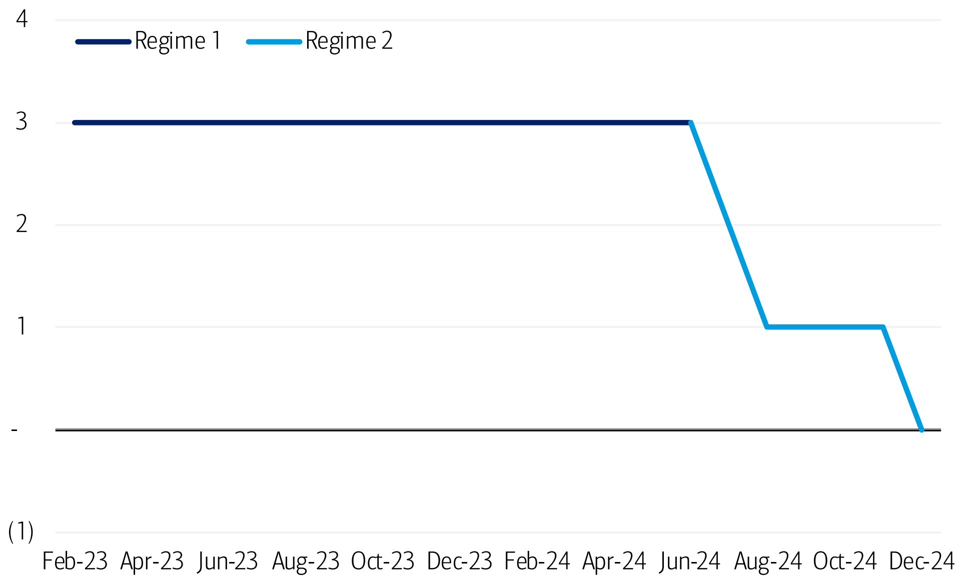
SOFR will likely rise faster once excess liquidity from ON RRP is drained

	Date	ON RRP	FF-SOFR	SOFR-IOER	EFFR-IOER
Regime 1	Feb-23	2,063	3	(10)	(7)
	Mar-23	2,062	3	(9)	(6)
	Apr-23	2,013	3	(10)	(7)
	May-23	2,008	3	(9)	(6)
	Jun-23	1,974	3	(9)	(6)
	Jul-23	2,058	3	(9)	(6)
	Aug-23	2,150	3	(9)	(6)
	Sep-23	1,755	3	(9)	(6)
	Oct-23	1,459	3	(9)	(6)
	Nov-23	1,266	3	(9)	(6)
	Dec-23	1,072	3	(9)	(6)
	Jan-24	982	3	(9)	(6)
	Feb-24	892	3	(9)	(6)
	Mar-24	797	3	(9)	(6)
	Apr-24	700	3	(9)	(6)
	May-24	625	3	(9)	(6)
	Jun-24	551	3	(9)	(6)
Regime 2	Jul-24	477	2	(8)	(6)
	Aug-24	402	1	(6)	(5)
	Sep-24	327	1	(6)	(5)
	Oct-24	253	1	(5)	(4)
	Nov-24	178	1	(4)	(3)
	Dec-24	120	-	(3)	(3)

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 16: Subjective SOFR/FF basis spread forecast (bps)
We project SOFR to remain at 3bp below FF until ON RRP has nearly drained



Source: BofA Global Research

BofA GLOBAL RESEARCH

Our revised SOFR/FF projections imply that the market is likely over-pricing the extent to which SOFR will rise towards FF by end '23. We think that this sustained upward SOFR pressure will likely need to wait until later in '24 to materialize. We therefore recommend fading the extent of SOFR/FF tightening in late '23. We agree with the market direction, but think it be pricing too much too soon. We recommend clients fade late '23 SOFR/FF levels at negative or zero rate levels.

Bottom line: near-term SOFR is biased lower with bill cuts & greater specials risk; this should bias SOFR/FF wider. Medium-term SOFR will likely be pulled higher with bill supply post debt limit; we think the market may be overestimating how quickly SOFR reaches or exceeds FF. SOFR is unlikely to reach FF until ON RRP is sufficiently depleted. The pricing of late '23 SOFR/FF basis implies too much tightening too soon.

Disclosures

Important Disclosures

BofA Global Research personnel (including the analyst(s) responsible for this report) receive compensation based upon, among other factors, the overall profitability of Bank of America Corporation, including profits derived from investment banking. The analyst(s) responsible for this report may also receive compensation based upon, among other factors, the overall profitability of the Bank's sales and trading businesses relating to the class of securities or financial instruments for which such analyst is responsible.
BofA Securities fixed income analysts regularly interact with sales and trading desk personnel in connection with their research, including to ascertain pricing and liquidity in the fixed income markets.

Other Important Disclosures

Prices are indicative and for information purposes only. Except as otherwise stated in the report, for any recommendation in relation to an equity security, the price referenced is the publicly traded price of the security as of close of business on the day prior to the date of the report or, if the report is published during intraday trading, the price referenced is indicative of the traded price as of the date and time of the report and in relation to a debt security (including equity preferred and CDS), prices are indicative as of the date and time of the report and are from various sources including BofA Securities trading desks.
The date and time of completion of the production of any recommendation in this report shall be the date and time of dissemination of this report as recorded in the report timestamp.

This report may refer to fixed income securities or other financial instruments that may not be offered or sold in one or more states or jurisdictions, or to certain categories of investors, including retail investors. Readers of this report are advised that any discussion, recommendation or other mention of such instruments is not a solicitation or offer to transact in such instruments. Investors should contact their BofA Securities representative or Merrill Global Wealth Management financial advisor for information relating to such instruments.
Rule 144A securities may be offered or sold only to persons in the U.S. who are Qualified Institutional Buyers within the meaning of Rule 144A under the Securities Act of 1933, as amended.
SECURITIES OR OTHER FINANCIAL INSTRUMENTS DISCUSSED HEREIN MAY BE RATED BELOW INVESTMENT GRADE AND SHOULD THEREFORE ONLY BE CONSIDERED FOR INCLUSION IN ACCOUNTS QUALIFIED FOR SPECULATIVE INVESTMENT.
Recipients who are not institutional investors or market professionals should seek the advice of their independent financial advisor before considering information in this report in connection with any investment decision, or for a necessary explanation of its contents.
The securities or other financial instruments discussed in this report may be traded over-the-counter. Retail sales and/or distribution of this report may be made only in states where these instruments are exempt from registration or have been qualified for sale.
Officers of BofAS or one or more of its affiliates (other than research analysts) may have a financial interest in securities of the issuer(s) or in related investments.
This report, and the securities or other financial instruments discussed herein, may not be eligible for distribution or sale in all countries or to certain categories of investors, including retail investors.
Refer to BofA Global Research policies relating to conflicts of interest.
"BofA Securities" includes BofA Securities, Inc. ("BofAS") and its affiliates. Investors should contact their BofA Securities representative or Merrill Global Wealth Management financial advisor if they have questions concerning this report or concerning the appropriateness of any investment idea described herein for such investor. "BofA Securities" is a global brand for BofA Global Research.
Information relating to Non-US affiliates of BofA Securities and Distribution of Affiliate Research Reports:
BofAS and/or Merrill Lynch, Pierce, Fenner & Smith Incorporated ("MLPF&S") may in the future distribute, information of the following non-US affiliates in the US (short name: legal name, regulator): Merrill Lynch (South Africa): Merrill Lynch South Africa (Pty) Ltd., regulated by The Financial Service Board; MLI (UK): Merrill Lynch International, regulated by the Financial Conduct Authority (FCA) and the Prudential Regulation Authority (PRA); BofASE (France): BofA Securities Europe SA is authorized by the Autorité de Contrôle Prudentiel et de Résolution (ACPR) and regulated by the ACPR and the Autorité des Marchés Financiers (AMF). BofA Securities Europe SA ("BofASE") with registered address at 51, rue La Boétie, 75008 Paris is registered under n° 842 602 690 RCS Paris. In accordance with the provisions of French Code Monétaire et Financier (Monetary and Financial Code), BofASE is an établissement de crédit et d'investissement (credit and investment institution) that is authorised and supervised by the European Central Bank and the Autorité de Contrôle Prudentiel et de Résolution (ACPR) and regulated by the ACPR and the Autorité des Marchés Financiers. BofASE's share capital can be found at www.bofaml.com/BofASEdisclaimer; BofA Europe (Milan): Bank of America Europe Designated Activity Company, Milan Branch, regulated by the Bank of Italy, the European Central Bank (ECB) and the Central Bank of Ireland (CBI); BofA Europe (Frankfurt): Bank of America Europe Designated Activity Company, Frankfurt Branch regulated by BaFin, the ECB and the CBI; BofA Europe (Madrid): Bank of America Europe Designated Activity Company, Sucursal en España, regulated by the Bank of Spain, the ECB and the CBI; Merrill Lynch (Australia): Merrill Lynch Equities (Australia) Limited, regulated by the Australian Securities and Investments Commission; Merrill Lynch (Hong Kong): Merrill Lynch (Asia Pacific) Limited, regulated by the Hong Kong Securities and Futures Commission (HKSFC); Merrill Lynch (Singapore): Merrill Lynch (Singapore) Pte Ltd, regulated by the Monetary Authority of Singapore (MAS); Merrill Lynch (Canada): Merrill Lynch Canada Inc, regulated by the Investment Industry Regulatory Organization of Canada; Merrill Lynch (Mexico): Merrill Lynch Mexico, SA de CV, Casa de Bolsa, regulated by the Comisión Nacional Bancaria y de Valores; Merrill Lynch (Argentina): Merrill Lynch Argentina SA, regulated by Comisión Nacional de Valores; BofAS Japan: BofA Securities Japan Co., Ltd., regulated by the Financial Services Agency; Merrill Lynch (Seoul): Merrill Lynch International, LLC Seoul Branch, regulated by the Financial Supervisory Service; Merrill Lynch (Taiwan): Merrill Lynch Securities (Taiwan) Ltd., regulated by the Securities and Futures Bureau; BofAS India: BofA Securities India Limited, regulated by the Securities and Exchange Board of India (SEBI); Merrill Lynch (Israel): Merrill Lynch Israel Limited, regulated by Israel Securities Authority; Merrill Lynch (DIFC): Merrill Lynch International (DIFC Branch), regulated by the Dubai Financial Services Authority (DFSA); Merrill Lynch (Brazil): Merrill Lynch S.A. Corretora de Títulos e Valores Mobiliários, regulated by Comissão de Valores Mobiliários; Merrill Lynch KSA Company: Merrill Lynch Kingdom of Saudi Arabia Company, regulated by the Capital Market Authority.
This information: has been approved for publication and is distributed in the United Kingdom (UK) to professional clients and eligible counterparties (as each is defined in the rules of the FCA and the PRA) by MLI (UK), which is authorized by the PRA and regulated by the FCA and the PRA - details about the extent of our regulation by the FCA and PRA are available from us on request; has been approved for publication and is distributed in the European Economic Area (EEA) by BofASE (France), which is authorized by the ACPR and regulated by the ACPR and the AMF; has been considered and distributed in Japan by BofAS Japan, a registered securities dealer under the Financial Instruments and Exchange Act in Japan, or its permitted affiliates; is issued and distributed in Hong Kong by Merrill Lynch (Hong Kong) which is regulated by HKSFC; is issued and distributed in Taiwan by Merrill Lynch (Taiwan); is issued and distributed in India by BofAS India; and is issued and distributed in Singapore to institutional investors and/or accredited investors (each as defined under the Financial Advisers Regulations) by Merrill Lynch (Singapore) (Company Registration No 198602883D). Merrill Lynch (Singapore) is regulated by MAS. Merrill Lynch Equities (Australia) Limited (ABN 65 006 276 795), AFS License 235132 (MLEA) distributes this information in Australia only to 'Wholesale' clients as defined by s.761G of the Corporations Act 2001. With the exception of Bank of America N.A., Australia Branch, neither MLEA nor any of its affiliates involved in preparing this information is an Authorised Deposit-Taking Institution under the Banking Act 1959 nor regulated by the Australian Prudential Regulation Authority. No approval is required for publication or distribution of this information in Brazil and its local distribution is by Merrill Lynch (Brazil) in accordance with applicable regulations. Merrill Lynch (DIFC) is authorized and regulated by the DFSA. Information prepared and issued by Merrill Lynch (DIFC) is done so in accordance with the requirements of the DFSA conduct of business rules. BofA Europe (Frankfurt) distributes this information in Germany and is regulated by BaFin, the ECB and the CBI. BofA Securities entities, including BofA Europe and BofASE (France), may outsource/delegate the marketing and/or provision of certain research services or aspects of research services to other branches or members of the BofA Securities group. You may be contacted by a different BofA Securities entity acting for and on behalf of your service provider where permitted by applicable law. This does not change your service provider. Please refer to the Electronic Communications Disclaimers for further information.
This information has been prepared and issued by BofAS and/or one or more of its non-US affiliates. The author(s) of this information may not be licensed to carry on regulated activities in your jurisdiction and, if not licensed, do not hold themselves out as being able to do so. BofAS and/or MLPF&S is the distributor of this information in the US and accepts full responsibility for information distributed to BofAS and/or MLPF&S clients in the US by its non-US affiliates. Any US person receiving this information and wishing to effect any transaction in any security discussed herein should do so through BofAS and/or MLPF&S and not such foreign affiliates. Hong Kong recipients of this information should contact Merrill Lynch (Asia Pacific) Limited in

respect of any matters relating to dealing in securities or provision of specific advice on securities or any other matters arising from, or in connection with, this information. Singapore recipients of this information should contact Merrill Lynch (Singapore) Pte Ltd in respect of any matters arising from, or in connection with, this information. For clients that are not accredited investors, expert investors or institutional investors Merrill Lynch (Singapore) Pte Ltd accepts full responsibility for the contents of this information distributed to such clients in Singapore.

General Investment Related Disclosures:

Taiwan Readers: Neither the information nor any opinion expressed herein constitutes an offer or a solicitation of an offer to transact in any securities or other financial instrument. No part of this report may be used or reproduced or quoted in any manner whatsoever in Taiwan by the press or any other person without the express written consent of BofA Securities.

This document provides general information only, and has been prepared for, and is intended for general distribution to, BofA Securities clients. Neither the information nor any opinion expressed constitutes an offer or an invitation to make an offer, to buy or sell any securities or other financial instrument or any derivative related to such securities or instruments (e.g., options, futures, warrants, and contracts for differences). This document is not intended to provide personal investment advice and it does not take into account the specific investment objectives, financial situation and the particular needs of, and is not directed to, any specific person(s). This document and its content do not constitute, and should not be considered to constitute, investment advice for purposes of ERISA, the US tax code, the Investment Advisers Act or otherwise. Investors should seek financial advice regarding the appropriateness of investing in financial instruments and implementing investment strategies discussed or recommended in this document and should understand that statements regarding future prospects may not be realized. Any decision to purchase or subscribe for securities in any offering must be based solely on existing public information on such security or the information in the prospectus or other offering document issued in connection with such offering, and not on this document.

Securities and other financial instruments referred to herein, or recommended, offered or sold by BofA Securities, are not insured by the Federal Deposit Insurance Corporation and are not deposits or other obligations of any insured depository institution (including, Bank of America, N.A.). Investments in general and, derivatives, in particular, involve numerous risks, including, among others, market risk, counterparty default risk and liquidity risk. No security, financial instrument or derivative is suitable for all investors. Digital assets are extremely speculative, volatile and are largely unregulated. In some cases, securities and other financial instruments may be difficult to value or sell and reliable information about the value or risks related to the security or financial instrument may be difficult to obtain. Investors should note that income from such securities and other financial instruments, if any, may fluctuate and that price or value of such securities and instruments may rise or fall and, in some cases, investors may lose their entire principal investment. Past performance is not necessarily a guide to future performance. Levels and basis for taxation may change.

BofA Securities is aware that the implementation of the ideas expressed in this report may depend upon an investor's ability to "short" securities or other financial instruments and that such action may be limited by regulations prohibiting or restricting "shortselling" in many jurisdictions. Investors are urged to seek advice regarding the applicability of such regulations prior to executing any short idea contained in this report.

This report may contain a trading idea or recommendation which highlights a specific identified near-term catalyst or event impacting a security, issuer, industry sector or the market generally that presents a transaction opportunity, but does not have any impact on the analyst's particular "Overweight" or "Underweight" rating (which is based on a three month trade horizon). Trading ideas and recommendations may differ directionally from the analyst's rating on a security or issuer because they reflect the impact of a near-term catalyst or event.

Foreign currency rates of exchange may adversely affect the value, price or income of any security or financial instrument mentioned in this report. Investors in such securities and instruments effectively assume currency risk.

BofAS or one of its affiliates is a regular issuer of traded financial instruments linked to securities that may have been recommended in this report. BofAS or one of its affiliates may, at any time, hold a trading position (long or short) in the securities and financial instruments discussed in this report.

BofA Securities, through business units other than BofA Global Research, may have issued and may in the future issue trading ideas or recommendations that are inconsistent with, and reach different conclusions from, the information presented herein. Such ideas or recommendations may reflect different time frames, assumptions, views and analytical methods of the persons who prepared them, and BofA Securities is under no obligation to ensure that such other trading ideas or recommendations are brought to the attention of any recipient of this information.

In the event that the recipient received this information pursuant to a contract between the recipient and BofAS for the provision of research services for a separate fee, and in connection therewith BofAS may be deemed to be acting as an investment adviser, such status relates, if at all, solely to the person with whom BofAS has contracted directly and does not extend beyond the delivery of this report (unless otherwise agreed specifically in writing by BofAS). If such recipient uses the services of BofAS in connection with the sale or purchase of a security referred to herein, BofAS may act as principal for its own account or as agent for another person. BofAS is and continues to act solely as a broker-dealer in connection with the execution of any transactions, including transactions in any securities referred to herein.

Copyright and General Information:

Materials prepared by BofA Global Research personnel are based on public information. Facts and views presented in this material have not been reviewed by, and may not reflect information known to, professionals in other business areas of BofA Securities, including investment banking personnel. BofA Securities has established information barriers between BofA Global Research and certain business groups. As a result, BofA Securities does not disclose certain client relationships with, or compensation received from, such issuers. To the extent this material discusses any legal proceeding or issues, it has not been prepared as nor is it intended to express any legal conclusion, opinion or advice. Investors should consult their own legal advisers as to issues of law relating to the subject matter of this material. BofA Global Research personnel's knowledge of legal proceedings in which any BofA Securities entity and/or its directors, officers and employees may be plaintiffs, defendants, co-defendants or co-plaintiffs with or involving issuers mentioned in this material is based on public information. Facts and views presented in this material that relate to any such proceedings have not been reviewed by, discussed with, and may not reflect information known to, professionals in other business areas of BofA Securities in connection with the legal proceedings or matters relevant to such proceedings.

This information has been prepared independently of any issuer of securities mentioned herein and not in connection with any proposed offering of securities or as agent of any issuer of any securities. None of BofAS any of its affiliates or their research analysts has any authority whatsoever to make any representation or warranty on behalf of the issuer(s). BofA Global Research policy prohibits research personnel from disclosing a recommendation, investment rating, or investment thesis for review by an issuer prior to the publication of a research report containing such rating, recommendation or investment thesis.

Any information relating to the tax status of financial instruments discussed herein is not intended to provide tax advice or to be used by anyone to provide tax advice. Investors are urged to seek tax advice based on their particular circumstances from an independent tax professional.

The information herein (other than disclosure information relating to BofA Securities and its affiliates) was obtained from various sources and we do not guarantee its accuracy. This information may contain links to third-party websites. BofA Securities is not responsible for the content of any third-party website or any linked content contained in a third-party website. Content contained on such third-party websites is not part of this information and is not incorporated by reference. The inclusion of a link does not imply any endorsement by or any affiliation with BofA Securities. Access to any third-party website is at your own risk, and you should always review the terms and privacy policies at third-party websites before submitting any personal information to them. BofA Securities is not responsible for such terms and privacy policies and expressly disclaims any liability for them.

All opinions, projections and estimates constitute the judgment of the author as of the date of publication and are subject to change without notice. Prices also are subject to change without notice. BofA Securities is under no obligation to update this information and BofA Securities ability to publish information on the subject issuer(s) in the future is subject to applicable quiet periods. You should therefore assume that BofA Securities will not update any fact, circumstance or opinion contained herein.

Certain outstanding reports or investment opinions relating to securities, financial instruments and/or issuers may no longer be current. Always refer to the most recent research report relating to an issuer prior to making an investment decision.

In some cases, an issuer may be classified as Restricted or may be Under Review or Extended Review. In each case, investors should consider any investment opinion relating to such issuer (or its security and/or financial instruments) to be suspended or withdrawn and should not rely on the analyses and investment opinion(s) pertaining to such issuer (or its securities and/or financial instruments) nor should the analyses or opinion(s) be considered a solicitation of any kind. Sales persons and financial advisors affiliated with BofAS or any of its affiliates may not solicit purchases of securities or financial instruments that are Restricted or Under Review and may only solicit securities under Extended Review in accordance with firm policies.

Neither BofA Securities nor any officer or employee of BofA Securities accepts any liability whatsoever for any direct, indirect or consequential damages or losses arising from any use of this information.